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(CONTINUATION OF THE OHIO NATURALIST)

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REPORT OF THE TWENTY-NINTH ANNUAL MEETING OF THE OHIO ACADEMY OF SCIENCE

EDWARD L. RICE, *Secretary.*

The Twenty-ninth Annual Meeting of the Ohio Academy of Science was held at Ohio State University, Columbus, Ohio, May 29 to 31, 1919, under the presidency of Professor Maynard M. Metcalf. Seventy-nine members were registered as in attendance; forty new members were elected.

On invitation of the Academy, a meeting of the psychologists of the State was held in connection with the Academy meeting, for the presentation of papers and the consideration of the formation of a Section for Psychology in the Academy. The organization of the section was accomplished, and the titles of papers presented are included in the program of the meeting of the Academy.

At the close of the formal session, the geologists, under the leadership of Professors J. E. Hyde and T. M. Hills, made an excursion to Newark for the study of glacial physiography and the Upper Waverly formation, while Professor W. M. Barrows conducted a zoological and botanical excursion to Sugar Grove

by *Tegenaria derhami*. Out on the grass in a dewy summer morning one can see hundreds of flat sheet-like webs which belong to the Agelenidæ. *Pholcus phalangiodes* makes an irregular web in cellars and packing houses. On flowers one can often find the small crab spiders with their forelegs extended, waiting for some unwary insect to fly or walk into the trap. In summer and fall *Argiope riparia* and *Argiope trifasciata* make their large vertical orb webs in weeds, tall grass and herbaceous plants. In bushes one is likely to find *Aranea trifolium* and *Metepeira labyrinthea*, both of which are orb weavers. If you pull off the bark from some old log, you may find *Dolomedes tenebrosus*. Lift up a stone and perhaps you will find *Lycosa avida* or some other wandering spider. Late in the fall *Epeira gigas* builds its web in bushes and far up in the trees. Moss and dead leaves are alive with small spiders. Look along an old rail fence, on top of fence posts or pull off the bark of a stump and you will probably find *Phidippus audax*, one of the jumping spiders.

In short, spiders are widely distributed, have a great variety of habits, and are adapted to various conditions. The distribution of spiders depends mainly on the method of capturing their food and the distribution of insects. Those spiders which have adopted the web as a means of capturing food have gained supremacy over non-netbuilding species in point of numbers. Spiders likely first used the silk only for making cocoons and egg cases. The web was probably developed first by those species which live in holes and lined the entrance with silk for protection. This may have developed later into a flat web or a flat web with a retreat at one end. From this simpler type we get a great diversity in web building. The ability to make silk and use it for a variety of purposes is certainly the important factor which has made spiders the most numerous and widely distributed order of the Arachnida.

The "ballooning habit" has enabled spiders to cross long stretches of water and become established on isolated oceanic islands; and to cross arms of the sea from one continent to another. It has also enabled them to cross elevations of land and become widely distributed which would be impossible were it not for the production of silk. The main use to which this silk is put, however, is in food getting and it is likely that it was from this necessity that the habit arose.

MANNER OF CAPTURING PREY.

Spiders are distinctly carnivorous creatures. They feed chiefly on insects but some species are known to feed on fish, birds, toads, frogs and crustaceans. Spiders are also cannibals and do not hesitate to devour weaker members of their own or other species.

They are extremely voracious and will eat a great quantity of food in a short period of time. They are also able to endure long fasts. I kept one alive in a box nearly three months without food. Its death at the end of that time was probably due not to starvation but to the season of the year as it will be remembered that most spiders die in the fall.

The most primitive way of spiders capturing their prey is seen in the Lycosidæ and Attidæ. These spiders never construct any snares but wander around in the grass or under stones in search of their prey which they capture by pouncing upon it from the rear. The struggle for existence is severer and as a result these spiders as a rule are not as numerous as web-building species.

Another class of spiders to which the genus Misumena belongs lie in wait for their prey on plants and flowers. They depend chiefly on protective resemblance to help them in capturing their prey and remain immovable until some unsuspecting insect walks into their jaws when they close in on it.

By far the larger number of spiders procure their prey by means of a snare. These spiders remain near or on this snare constantly and capture a great number of insects often a great many more than are used for food. These snares or webs present a great variety of forms, ranging from a small flat sheet on the surface of the ground to the large orbicular webs sometimes two feet or more in diameter built vertically in grass, weeds or shrubs. In giving determinations in this paper we have for the most part given what the spider captured and not what it actually ate. It will be seen that considered from an economic standpoint the value of the spider ought to be rated by the insects it destroys and not by what it eats.

There is still another class of spiders which feed on what has been captured by other spiders and are called commensal spiders. Most of these are small spiders and relatively unimportant from an economic standpoint.

The Lycosids and Attidæ capture their prey by stalking it and jumping on it from the rear. Most of them have powerful chelicerae which they sink into their victim and so cause almost instant death. A pair of poison glands located in the cephalthorax and opening on the tip of the chelicerae by means of ducts is the chief agency that helps in dispatching their prey. This acts almost instantly. I have taken beetles and *Lygus pratensis* away from *Phidippus audax* and *Lycosa fatifera* almost the instant they struck it, always with the same result, the insect was dead. Although most spiders suck only the juices from insects this is not always the case. A *Lycosa fatifera* which I had in captivity, ate the body wall and entire chitinous covering of the larvæ of Elateridæ and Cucujidæ. Another ate an entire grasshopper. The prey in each case being crushed and rolled until it was a mass of pulp. A writer in *Nature*, April 10, 1913, tells of a spider that devours the flesh of fish.

The net building spiders have a variety of ways of capturing their prey. The Agelenidæ or Funnel Weavers rush on the victim, sink the chelicerae into the insect, then withdraw a short distance. If the insect is not killed, the act is repeated until the insect is disabled. It is then taken to the mouth of the funnel or inside the tube. If the insect is a large one it is usually left at the mouth of the tube where the spider ties it to the web by the legs. A small insect is usually carried directly into the tube.

The orb weavers rush on the insect and pull out a band of silk when they are near the insect. This is thrust against the insect to which it adheres very readily. The band is pulled from the spinnerets by one of the hind legs and by changing from one hind leg to the other the spiders keep at a safe distance from the insect and yet wrap up the insect so quickly that one can scarcely see how it is done. The spider is perfectly at home in its web and can pounce directly on small insects or if the insect has a poisonous sting it can keep it at a safe distance.

Some spiders build a retreat and spin a trap line from the retreat to the web. They hold this trap line taut and this holds the snare taut in turn, but when an insect strikes the web it loosens its hold and the insect becomes entangled in a mesh of threads.

Some of the Theridiidæ eject on the insect liquid silk from their spinning tubes and I suspect, although I have not proven it, that this liquid silk has a dissolving effect on the chitin. *Theridium tepidariorum*, one of the common Theridiidæ, destroys many beetles in barns and cellars and the chitinous parts of the insects seem to disintegrate in a short time after it gets into the spider web.

There are many remarkable color adaptations, but since we believe they are mostly adaptations for protection and not food getting, they will not be discussed here.

GENERAL DISCUSSION.

In determining the economic status of spiders several factors should be taken into consideration. The principal ones being the number of spiders of any given species on a certain area, the number and size of the insects used as food, and the economic status of the insects fed upon.

To gain definite information on these things has been the object sought in these observations. Although it is of necessity rather fragmentary, it is hoped that the records will show to some extent the part that these creatures play in the balance of nature. Besides the species of which records are given, many more were found in the same localities, but only the more numerous ones were studied.

Many different spiders of widely separated families may be found living together within a few feet of each other. But each species usually has a preference for a certain kind of condition, as *Argiope riparia* makes its web preferably in tall grass and weeds.

One example of the diversity of species in a limited area will be given. I found on and around a rose bush (*Rosa carolina*) about 20 feet long and 19 feet wide, the following species:

Two individuals of *Metepeira labyrinthea*.
Eight individuals of *Epeira domiciliorum*.
One individual of *Epeira gigas*.
Eleven individuals of *Epeira trifolium*.
Three individuals of *Argiope riparia*.
Eight individuals of unidentified species.

Another example that might be given is an observation made near a stump. The area was about 10 feet square. One of the Attidæ, *Phidippus audax*, was stalking a grasshopper. The non-net building species were further represented by *Castianeira descripta* and *Lycosa avida*. An *Argiope riparia* had a web at the edge of the stump on a raspberry bush. *Epeira trivitatta* had its web on the same stalk and on a brush pile beside the stump were the webs of seven *Agelena naevia*.

The manner of capturing the prey is also of importance. If a spider builds a vertical web of considerable size and places it in weeds or grass it is evident that a great many more insects will be destroyed than if the spider built a horizontal web close to the ground or built no web at all. If the web is flat and horizontal, like those of the Agelenidæ, the class of insects will be more restricted than in the case of the large Orb Weavers. The location of the web of *Argiope riparia* accounts for the great diversity of the insects captured. A spider which captures its prey by jumping on to it from the rear is not likely to capture as many insects as would a net building species.

Besides the fact of the location of the web, the manner of actual capture seems to be of some importance. The Orb Weavers which we have observed depend on tactile responses to secure their food. If one throws something else in their webs they rush at it in the same manner as if it were an insect. The consequence is they roll up in their webs nearly every insect that chances to strike the webs.

The Lycosidæ and Attidæ depend more on sight and can see for some distance. Misumena remains perfectly quiet until the insect comes to it. The instant the insect comes within grasping distance there is one quick move and the insect is dead. The chances of securing prey in these cases are smaller in comparison to net building species.

In studying the food relations of spiders most of the observations were made directly in the field. Although excursions were made to many different locations, most of the data was collected on an area of about eighty acres. Besides the field observations, I captured a great many specimens and fed them in captivity. I secured about sixty common paste-board shoe boxes and a window pane to cover the top of each box. With this kind of a cage I was able to watch the spiders and

see what they would do when insects were put into the box. Spiders kept in captivity must be supplied with water daily or they will soon die. If they are "watered" with a medicine dropper they soon learn to come and drink from the end of the dropper. By gently pressing on the bulb of the dropper the spider can be supplied with water with but little trouble and the proceeding is really interesting.

CLASSIFICATION.

In classifying the species of spiders studied, Bank's Catalogue of Nearctic Spiders was followed. Following each species is the name of the man who identified it. A later catalogue on the synonomy of spiders is Petrunkevitch's which may be found in Volume XXIX, Bulletin of the American Museum of Natural History. The classification by families is as follows:

Lycosidæ: *Lycosa avida* Walckenaer.
Lycosa carolinensis Walckenaer.
Lycosa fatifera Hentz.

Attidæ: *Phidippus audax* Hentz.
Phidippus podagrosus Hentz.

Clubionidæ: *Castianeira descripta* Hentz.

Thomisidæ: *Misumena vatia* Clerck.

Pisauridæ: *Dolomedes tenebrosus* Hentz.

Dictynidæ: *Dictyna frondea* Emerton.

Agelenidæ: *Agelena naevia* Walckenaer.
Coras medicinalis Hentz.

Epeiridæ: *Metepeira labyrinthea* Hentz.
Leucauge venusta Walckenaer.
Epeira trivittata Keyserling.
Epeira domiciliorum Hentz.
Epeira foliata Koch.
Epeira trifolium Hentz.
Epeira gigas Leach.
Argiope trifasciata Forskal.
Argiope riparia Hentz.

DISCUSSION OF THE FOOD HABITS OF EACH SPECIES.

Lycosa avida Walckenaer.

Lycosa avida was the most common member of the Lycosids found. It was abundant in pastures and along streams, especially where there were a great many loose stones and was also often found under boards lying on the ground around buildings. This spider varies greatly in color, some individuals were nearly white while others were deep gray and some almost black.

Several individuals were kept in captivity and their food relations studied. Although this method is not entirely satisfactory, it is the best method that can be used with some Lycosids such as this one. The fact that they are constantly moving about and keep in hiding a greater part of the time make any other method of studying their food habits difficult and almost impossible.*

Lycosa carolinensis Walckenaer.

The records given on *Lycosa carolinensis* are for a single individual which was the only one seen during the summer. This was a very large one, measuring nearly one and one-half inches. Unfortunately in my absence the cage in which it was kept met with an accident late in the summer, the spider escaped and the record had to be discontinued.

Since this was a large spider I wanted to see how large an insect it would attack. A large Cicada was placed in the box with it on the morning of July 23d. The spider would not attack the Cicada but kept at the other end of the cage. During the night the Cicada was killed and the next morning, July 24th, only the chitinous shell remained, the head, the thorax, and abdomen having been completely hollowed out. From this incident and similar ones I have concluded that the Lycosids seek their prey at night.

This spider usually only sucked out the soft parts and left the chitinous parts such as legs, wings, wing covers, and body wall but in the case of a few flies the whole insects were eaten. When the whole insect was eaten, the victim was crushed and

*A tabulated list of the insects which were fed upon by this and all succeeding spiders whose food habits were observed will be found at the end of the paper on page 255.

rolled between the heavy chelicerae until there was nothing but a mass of fine pulp.

The following is the record of the insects placed in the cage with the spider:

July 22—Larva of *Lachnosterna, Drasteria crassiuscula, Promachus vertebratus, Pseudopyrellia cornicina.*
July 23—*Chrysopa oculata, Cicada linnei.*
July 24—*Tipula flavicans, Melanoplus differentialis.*
July 25—*Eristalis tenax, Pelidnota punctata,* Ischnopetra pennsylvanica.**
July 26—Larva of *Elateridæ* (Probably *Ludius attenuatus*).
July 29—*Dissosteira carolina.*
July 30—Two *Gryllus abbreviatus.*
August 2—*Apis mellifica,* Microcentrum retinerva.**
August 6—*Diplax rubicundula.*
August 8—Larva of *Papilio polyxenes.**
August 9—Larva of *Cucujus clavipes*, Larva of *Tenebria molitor, Drasteria erechta.*
August 10—*Oecanthus niveus, Coccinella 9-notata.*
August 11—*Musca domestica.*
August 12—*Nabis ferus, Lygus pratensis.*
August 13—*Formicidæ,** sp. undetermined. *Tiphia inornata.*
August 16—*Tabanus lineolatus.*
August 20—*Oecanthus niveus, Melanostoma mellinum, Epicauta pennsylvanica.**

Lycosa fatifera Hentz.

This spider is widely distributed and has been described under a variety of names and conditions. *Lycosa fatifera* varies from a reddish brown to black. It was common at Crestline, Ohio, during the entire summer. I have found as many as three individuals under one board but this is rather uncommon. One may find one with but little search, however, by lifting up boards and stones. It is found in meadows, in wheat fields, in oats fields, and in fact it can be found most anywhere.

Because of its wandering habits and comparatively good powers of vision this spider is difficult to study in the field and most of the records were obtained from specimens kept in captivity. Like the other Lycosids this spider will not attack insects with strongly chitinized bodies if other food can be obtained. Coleoptera were nearly always refused. The chelicerae are large and strong and well fitted for crushing prey. Small insects and larva are crushed and rolled into a mass of

*Indicates the insect was not eaten, but was placed in the cage.

pulp and often the entire insect is eaten. Larva of Elateridæ and Cucujidæ were fed this spider. The body walls of these insects are strongly chitinized but the entire larva was frequently eaten. One of them also ate an entire grasshopper. When the larva was not entirely eaten as was sometimes the case, a slit was made down the dorsal side of the larva and the soft parts taken out. Although it would not eat Coleoptera with strongly chitinized body walls and hard elytra, such beetles as *Chlænius sericæus* which have less strongly chitinized body walls were sometimes eaten.

Some of the beetles which were offered to it but were not eaten:

Nytcobates pennsylvanicus, Tetraopes tetraophthalmus, Evartus sodalis, Pterostichus stygius, Pterostichus lucublandus, Rhynchites bicolor, Lucanus dama, Chauliognathus pennsylvanicus, Epicauta pennsylvanica, Myrmicidæ were offered but were not eaten.

One of these spiders which was kept in captivity ate in a single day, a cockroach (*Ischnoptera pennsylvanica*) and three large grasshoppers. Two of the grasshoppers belonged to the Acrididæ and the other one was one of the Locustidæ. One of the Acrididæ was nearly as large as the spider itself. These insects were eaten on June 29th. After that the spider would not eat anything and died on July 5th.

Another one was fed entirely on larva of Elateridæ for one week to find out how many would be eaten in a limited period of time. These larvæ were kept in the cage all the time and the spider had the opportunity of eating as many as it wanted. Larvæ were eaten on the dates given as follows: One larva each on July 22, 23, 24, 25, 27, 29.

These larvæ were about an inch in length and were likely the larvæ of *Ludia attenuatus*. Sometimes the whole larva was eaten and at other times only the visceral parts.

Phidippus audax Hentz.

Phidippus audax is the most common jumping spider in central Ohio. The three white spots on the back of the abdomen and the green cheliceræ make it a spider that can be easily recognized.

It is a common spider but we could scarcely say abundant. It is most often found on rail fences, under sticks, on fence posts and on the outside of buildings. Wood seems to have

some attraction for this spider and one can often find them in a clearing by pulling the bark off an old stump.

To one who can see the humorous side in the action of animals, I know of nothing of more interest than watching one of these spiders. When one of them encounters a large insect or another spider, he holds his head erect often turning it aside like a dog intently listening and lifts up one of his front legs as if to say, "I have the right of way."

Phidippus is a bold spider and will attack insects much larger than itself. I have found one sitting on the side of a stump eating a male cockroach (*Ischnoptera pennsylvanica*) two or three times the size of the spider; another one in blackberry bush eating a *Vespa germanica*. I have noted them in a rail pile eating grasshoppers several times the size of the spider. One which was kept in captivity ate a bald-faced hornet, *Vespa maculata*. As I did not see him capture the hornet I am unable to say as to whether the hornet died and the spider seized it after it had died or whether the spider killed it. I think the latter to be the case as I have never seen this spider eat an insect that has died a natural death.

It is interesting to watch one of them stalk such an insect as *Lygus pratensis*. One sunny afternoon I saw one of these spiders after a *Lygus pratensis* in a patch of tall weeds. The insect evidently was aware of the presence of the spider but seemed to misjudge the danger. It flew from one branch of the weed to the other with *Phidippus audax* constantly on its trail. The spider reminded one of a squirrel up in a big tree jumping from one branch to another, now descending a short distance, running out on a limb, now jumping to another tree, and running up the trunk to a more favorable situation for another jump. He kept up the hunt for sometime, each time he was about ready for the fatal jump, the insect flew to another branch of the weed but his stealth and persistence won. Slipping up a branch from the rear he jumped onto the insect. I took the insect from him immediately but it was already dead.

How this spider as well as *Agelena nævia* and the Lycosids can kill an insect so quickly has long puzzled me. In J. Henry Fabre's book entitled, "The Life of the Spider," is an explanation which seems to solve the problem. Mr. Fabre says the spider sinks the cheliceræ into the insect's ganglion, which is the only place that a thrust from the cheliceræ would cause

instant death. This fact, it seems, is the reason why most spiders that attack insects by jumping upon them will seldom ever attack an insect with a strongly chitinized body but will attack a large insect with soft body coverings.

I have often seen *Phidippus audax* pursuing other spiders and occasionally have seen them eating small spiders such as, *Xysticus gulosus* and *Philodromus vulgaris*. But they are often the victim themselves. When one of these spiders jumps or falls into the web of *Argiope riparia* or *Argiope trifasciata* it is helpless and late in the fall many of them become the prey of these spiders.

Another incident shows that this spider possesses something which borders upon intelligence. One morning I was watching one near a large stump. He jumped around evidently in search of prey for sometime. Presently he spied a small spider, *Castianeira descripta* running about and began to pursue it. *Castianeira descripta* was too swift for him and he soon gave up the chase. Next he jumped upon a Funnel Weaver's web, *Agelena nævia*, and began searching it. The Funnel Weaver soon came from its hiding place and chased Phidippus off the web. Soon he spied a grasshopper which was crossing a small stick which was lying on top of two larger sticks.

The two larger sticks formed the base and hypotenuse of a triangle. The stick forming the base was a very large limb. Phidippus peeped up over the edge of this piece and saw the grasshopper with its head pointed in his direction. He immediately ran down the under side of the large limb to where the two large limbs came to a point and ran back up the smaller to the rear of the grasshopper. When he had stolen up to within a couple of inches of the grasshopper he made a leap and landed on the grasshopper's back.

Phidippus audax was watched to see what insects were eaten both under natural conditions and in captivity. In the field I have found them eating: Tabanidæ, Blattidæ, Vespidæ, Capsidæ, Acrididæ, Gryllidæ.

Tests were made to see how many insects of the same species this spider would eat in one week, one test on *Lygus pratensis* was as follows: Oct. 17, Oct. 18, Oct. 19*, Oct. 20*, Oct. 21, 3*; Oct. 22*, Oct. 23, 4*; Oct. 24, 2.

*Indicates insect was placed in the cage, but was not eaten.

The food of this spider where observed consisted chiefly of Diptera, Orthopera, Hemiptera, and Hymenoptera. No case was noted where this spider fed on Coleoptera. The juices are sucked from the insect, and the chitinous parts discarded.

Phidippus podagrosus Hentz.

Phidippus podagrosus is less common than *Phidippus audax*. Comstock calls this spider *Phidippus insolens*. It was found on various kinds of plants. Several females were found in oat fields. This spider is not abundant, but it was not difficult to find a few individuals in the localities where it was studied. The records were all made from spiders kept in captivity.

Castianeira descripta Hentz.

Castianeria descripta is a small black spider with red markings on the abdomen. It is commonly found under stones in meadows and pastures.

It was a common spider at Crestline, Ohio, during the entire summer. One could scarcely turn up a stone in pasture fields without finding one of these spiders. Although they were plentiful, it was difficult to gather much information as to what their food was under natural conditions. Several individuals were kept in captivity and a list of the insects eaten in captivity will be found in the table already mentioned.

Misumena vatia Clerck.

Misumena vatia is a common yellow crab spider which lives on plants and is most often found among flowers. They can usually be found in such flower clusters as Ironweed (*Vernonia gigantea*) and Boncset (*Eupatorium perfoliatum*).

They lie in wait until some insect flies or walks into their chelicerae when it is seized. As far as I have observed they make no attempt to capture insects as other spiders do, depending wholly upon their coloration as a protective resemblance to aid them in securing their prey. One of these spiders when getting its prey sits with the abdomen down in the flowers and usually with the front legs extended. Its color is usually so nearly that of the flower upon which it rests that it can be picked out only with difficulty. The unsuspecting fly or bee which comes to feed upon the nectar of the flower sooner or

later walks into the clutches of this spider. The moment the fly comes within closing distance of the front legs and chelicerae, they are shut down like a trap. I have observed a fly alight on a flower cluster an inch or two from one of these spiders and begin walking on the flower cluster, the spider never moving, although it seemed to me that it must have been aware of the presence of the fly. The fly walked around on the flower for sometime, but finally came directly into the "jaws" of the spider. One quick movement of the legs and the fly was dead.

I have tried feeding some of them in a cage, but always with the same result. The spider would remain on the side of the box and wait till the fly or jassid jumped or flew within grasping distance of the chelicerae and front legs. The insect could easily have been pursued, but the spider preferred to let the insect walk into the trap.

One which I observed on top of a pump lived entirely on flies. An old tin cup turned upside down on top of the shaft of the pump was its home. This one remained in the same place for a long time. Several different species of flies were eaten. *Musca domestica*, *Pseudopyrellia cornicina* and *Haematobia serrata* were the species which were taken from the spider. The location of this spider made flies about the only kind of insect which could be captured. All those which were observed on flowers preferred flies to any other kind of insects. Small bees, Andrenidæ, were also eaten.

A few references are made to the food of this spider. In an article entitled "Change of Color and Protective Coloration in a Flower Spider," (*Misumena vatia*), J. Ent. Soc., Vol. 13, pp. 85-96, Dr. Alphaeus Packard states that he saw one of these spiders holding a green fly (*Lucilia caesar*). He fed house flies to four of them which he had in captivity. Dr. Packard also notes one which had an Andrenid bee in its chelicerae.

Besides the flies mentioned, this spider was observed to feed upon flies belonging to the Syrphidæ, the Dolichopodidæ, the Scatophagidæ, and the Asilidæ. A few bees were eaten belonging to Andrena and Colletes. I also induced one to eat *Lygus pratensis* and Jassids. I tried to feed them Gryllidæ, Acrididæ, and Nabidæ, but never succeeded in getting one to eat any of these insects. As far as I have observed their food consists chiefly of flies and I believe they will eat any kind of Diptera.

Professor Edouard Haeckel, Bulletin Sc. France et Belgique, Vol. XXIII, 1891, says that the food is confined to two species of Diptera. The observations I have made, although they may not be as complete as Mr. Haeckel's, do not bear out this statement.

Dolomedes tenebrosus Hentz.

Dolomedes tenebrosus is one of the largest of our spiders. It lives under the bark of trees, in bushes, and usually near the water. The female carries her egg sac in her chelicerae and before the young are ready to hatch she makes a web for the young spiderlings to live upon. One of these spiders which was captured under the bark of a red oak log was kept in captivity and she raised two broods during the summer. This spider was not abundant at Crestline and the food records are only for one individual.

Dictyna frondea Emerton.

This is one of the very small spiders and was frequently found on small bushes, especially blackberry and raspberry bushes. It makes an irregular web on the top of leaves by drawing the edges of the leaves together. No retreat is constructed and the spider remains in the web all the time.

If one looks on top of leaves on bushes in clearings he is almost certain to find this spider. They are so small that they are easily overlooked.

The food of this spider consisted chiefly of a small fly belonging to the Anthomiidæ and the horn fly, *Haematobia serrata*. The Dolichopodidæ also formed part of their food. An occasional Jassid jumped into the web and if it was not too large to destroy the web, it was also eaten. Midges (*Chironomidæ*) and mosquitoes formed a small part of their food.

From an economic standpoint this spider is not as important as many of the larger spiders, but the fact that they destroy a considerably number of flies and mosquitoes makes them of some importance at least.

Agelena naevia Walckenaer.

Even the casual observer has noticed the web of this spider. The webs are most often in grass, but they may be made in a great many other places, such as among stones, around windows in buildings, on brush piles and a great variety of places.

The web varies somewhat but the typical web is a horizontal sheet, wide at the outer end and with a tubular retreat or funnel at the other. The web is concave and often has an irregular network of threads above it which serves as a barrier to arrest the flight of insects.

When in the grass, the web is made close to the ground and is firmly constructed. The sheet is made by stretching long threads from one side to the other, the threads being nearly parallel. Many fine threads cross these in all directions. At first the web does not have much thickness, but every time the spider crosses it she spins a dragline and the continued use of a web for a long time makes a rather thick structure. If the spider is not molested it will use the same web and stay in the same place for months.

The tubular retreat is used for emergencies. If too large an insect chances to get into the web or if the spider is pursued by one of the Pompilidæ, it retreats to the tube and escapes into the grass or if the web is high enough off the grass, the spider runs out the retreat and round on the bottom of the web and comes upon the top of it again.

Agelena will attack insects much larger than itself. On one occasion I observed one of the Pompilidæ capture a small orb weaver, *Aranea thaddeus*, which had made its web over the web of this funnel weaver's. The small orb weaver was a heavier load than the wasp could carry and both the wasp and its victim fell down upon the web of the funnel weaver. Agelena rushed out from the retreat and gave battle with the wasp. The wasp became frightened and flew away leaving the funnel weaver in possession of the orb weaver, which was carried back to the retreat, where it was eaten.

If the web of this spider is destroyed, it can be reconstructed in a single day. The web is very different in position from the orb weavers and the spiders instead of hanging on the web, run about on the top surface of it. There is nothing adhesive on the web and many insects are able to get off the web in a short time.

The manner of capturing insects is also quite different from that of the orb weavers. When an insect falls upon the web the spider rushes out from the retreat and sinks its cheliceræ into it. After the first thrust she usually withdraws a short distance to see how her victim is faring. If the insect has not been

paralyzed or killed outright, she makes another rush at it. This is repeated until the insect is so disabled that it is not capable of making any resistance. Sometimes at the first thrust of the chelicerae, the insect is not disabled and if the insect is a very large one or able to give her a good fight, the spider gives up the battle and withdraws to her retreat to await a less formidable foe. If the insect is a small one, she comes out of the retreat, seizes the victim with her chelicerae and returns to the retreat with it. A large insect is usually dragged to the entrance of the funnel where the spider ties it to the web. This is done by circling around and around the insect so as to tie it to the web. The insect is left at the entrance of the funnel, sometimes it is carried in immediately, until it is needed as food, then it is carried into the web, where the soft parts are eaten. After the insect is crushed and mashed by the chelicerae, the remaining hard parts are dragged out of the tubular retreat and carried to the edge of the web where they are cast over.

Small insects are so crushed and ground up by the chelicerae that scarcely anything is left of them. One which I fed 122 jassids in a week ground them up so completely that nothing was left but fine powder when I removed the web from the cage in which the spider was kept.

Miris dolobratus was fed to another which I had in captivity. In four days this one ate 39 of these insects and there was not enough fine powder and wing covers remaining to fill a half-inch vial. Grasshoppers and similar insects which are more chitinized, are not entirely ground up, the wing covers, legs and body wall being usually discarded.

The position of the web of this spider, to a certain degree restricts the kinds of insects captured. Being near the ground as it usually is, the greater number of insects which chance to fall upon the web will belong to the grasshoppers, Jassidæ and Capsids. The barrier strands which arrest the flight of insects will cause some flying insects to be thrown upon the web. The flat surface of the top of the web enables some insects to make their escape unless they are immediately attacked by the occupant of the web. The insect will not be captured or entangled in the web unless the spider wants it for food. It is also seen that the insects found in the webs will be those the spider has tied there.

Agelena will attack a grasshopper much larger than itself but will rarely attack a large beetle. The probable reason for this seems to be that the Agelena relies on dispatching her victim by striking a vital spot with its chelicerae. In case the insect is strongly chitinized as most beetles are, she seldom ever puts up a fight, but prefers to let them alone. I think a probable reason for this is, she is afraid to engage in mortal combat with an insect of which she is unable to strike the fatal spot at the first blow and in that case injury may come to herself. Smaller insects and grasshoppers are easily killed and often one sees this spider dragging a grasshopper over the top of the web holding the hind legs with the chelicerae.

The feeding period extends over a long period of time. The first funnel webs were noted on May 4, 1913, and the last ones were seen the 28th of October, 1913. This fact, together with the great numbers of them and the kind of insects they eat, make it, in my opinion, the most valuable spider to the agriculturist from an economic point of view. The fact that this spider destroys almost entirely insects of an injurious character is a point worth considering. The food consists mostly of insects that do not have strongly chitinized bodies, but this spider, like many others, I believe, will eat most any kind of insect if the situation of the web makes it necessary to do so. The situation of the web and the prevalence of the insects in large measure determine the character of the food. Since Agelena's web is most often in the grass, where grasshoppers, jassids and capsids are the prevalent insects, they are most liable to be the food. The peculiar mode in which these insects fly from place to place also increases the chance of their alighting on the web of this spider. An insect such as a bee usually flies at some distance from the ground and does not alight unless it is attracted by a flower or something similar but grasshoppers and jassids fly from one place to another and come down in a sort of hit and miss way, so that their chances of falling upon a web of this kind are greatly increased.

The number of these spiders in any given area is enormous. In order to determine how numerous this spider is, I counted them on several different areas. In a clearing which was full of stumps and brush piles and which is an ideal place for this spider, I counted them in midsummer when most of them were nearly full grown. On an area of two and one-half acres,

nine hundred and thirty-four individuals were counted. On a brush pile six feet in diameter, I counted thirty-two of these spiders. Another count was made along a lane for a distance of one hundred and thirty-two feet, the count being taken on both sides of the lane between the ditch and the fence. In this distance there were two hundred and sixty spiders.

Counts similar to these may be made almost anywhere in old pasture land, along a roadside, or any place where the spider is not likely to be disturbed.

This spider is a voracious eater but it can also do without food for a long time. One of them was penned up in a tin box for a month with nothing to eat. At the end of that time the spider seemed to be in just as good condition as when put into the box.

This same spider captured forty jassids in a single day. If the spider did not capture them in a short time, the jassids were able to crawl off the web. More than forty were thrown on the web, some of them escaping before the spider captured them. Each jassid was picked up by the chelicerae and carried back into the retreat. They were left in the retreat until they were needed as food. Like most other spiders Agelena will capture many more than those it needs as an immediate food supply.

Their chances of procuring food are limited if one may judge by the number of spiders seen feeding. Out of the great number of webs visited only a small per cent was found to be feeding or even had any insects in the web. I think this is why the spider captures all the insects possible when the food supply is plentiful. Several tests were made to see how many insects would be eaten in a limited time. One of them was fed jassids, chiefly *Phlepsius irroratus*, as follows: July 1, 15; July 2, 10; July 3, 21; July 4, 26; July 6, 25; July 7, 25; total, 122.

Another was fed larval grasshoppers, as follows: July 1, 5; July 2, 6; July 3, 8; July 4, 5; July 5, 5; July 6, 6; July 7, 5; total, 40.

Another was fed *Miris dolobratus*, which was very abundant at that time: July 1, 12; July 2, 5; July 3, 13; July 4, 9; total, 39. After July 4, this one refused to eat any more and would not eat for several days.

I tried feeding Agelena with several kinds of beetles but they were nearly always rejected. I tried to feed *Rhynchites bicolor* to an Agelena which had its web in a rose bush on which

this insect was plentiful. The spider came from the retreat when the insect was thrown upon the web but seldom ever tried to capture it. One day I killed one of these beetles and threw it upon the web. Two hours afterward I came back and found the spider had eaten the soft parts of the beetle. Similar experiments were tried with Coccinellidæ but the spider allowed the beetle to escape. I think this spider will eat beetles if it cannot get other food. The fact that few such insects were found in their webs is due to the abundant supply of grasshoppers which formed their chief food supply. Later in the year *Phytonomus punctatus* was sometimes found in the web of this spider. This beetle had a strongly chitinized body wall and if this is eaten I think other beetles would be captured if no other food could be obtained.

Several hundred webs were examined but spiders were feeding in a very small per cent of the webs. The following data is given on the two hundred and twenty-one webs in which spiders were seen feeding.

53% contained Grasshoppers; *12% contained Ants; 8% contained Jassidæ; 7% contained Capsidæ; 4% contained Syrphidæ; 3% contained Drasteria erechta and Drasteria crassiuscula; 2% contained Gryllus abbreviatus; 2% contained Culex pipiens; 2% contained Harvestmen and spiders; 1% contained Phytonomus punctatus; 1% contained Ceresa bubalus; 1% contained Sapromyza lupulinæ; 1% contained Fulgoridæ; 1% contained Tipulidæ; 2% all other insects.

Coras medicinalis Hentz.

This spider is named *Coras medicinalis* by Professor Comstock, Emerton places it in another genus and calls it *Coeletes medicinalis*. It is a grayish spider about half an inch in length and lives in hollow trees, under blocks of wood and in crevices. The web is similar to *Agelena nævia* and has a funnel retreat.

One specimen was kept in captivity four months and the food records are given on this single individual.

*The percentage of ants is higher than it would normally be, but is given according to the data collected. The spiders which ate these ants had their webs in a clearing around stumps. The ants captured were kings and queens which became entangled in the webs at mating time. This data on the ants was collected in a restricted area and was not obtained over a large area of varied conditions as the rest of the data was. I have watched the workers of several colonies of ants run around over the webs of spiders which were near the ants' nests and the spiders paid no attention to the ants at all, so it is my opinion that Grasshoppers, Capsids and Jassids are preferred to ants ordinarily.

Metepeira labyrinthea Hentz.

Metepeira labyrinthea was not a common species in the localities where it was studied. The web of this spider consists of both an orb web and an irregular web. The orb web is built below and in front of an irregular web. A retreat is made in the irregular net. This retreat is made of leaves so placed as to make a small tent for the spider. One or more trap lines extend from the retreat to the orb web. When an insect becomes entangled in the orb web the spider descends on the trap line and ties it up in the web. If the spider is in need of food the insect is taken back to the retreat where the soft parts are eaten and the remaining parts are thrown from the web. The web of this spider was found in bushes and berry patches but it was not common either at Crestline or Columbus.

Lecauge venusta Walckenaer.

This is one of our most beautiful spiders. It is green tinged with silvery white and golden. Although it is widely distributed it was not abundant in the places where it has been observed. The web of this spider is of the complete orb type and is built horizontally and not vertically as is most often the case with orb weavers.

The webs were found usually around shrubbery or in the woods. Deep woods is preferred to more open places. I have frequently found a web stretched across the top of a hollow stump. An old log house which was frequently visited, was one of the places where this spider was abundant. The webs here were constructed between the old logs which were the sills for the floor, the old board floor having been removed. A lilac bush on the sheltered side of the house where the board siding had been removed projected into the open space. Lecauge seemed partial to constructing its web inside the house and attaching some of the "guy" lines to this bush. Often these lines were ten or twelve feet long. No barrier web was built but the spider usually remained on one of these lines above the web and when an insect struck the web it ran down the line to capture the insect.

Sometimes in webs which were constructed in other places, the spider remained in the center of the hub. Although this spider was carefully studied wherever it was found, the lack of

numbers does not permit giving very extensive data on food relations. Because of the small size of this spider, it feeds on small soft-bodied insects. It is easily frightened and permits insects which struggle much in the web to extricate themselves.

Epeira trivitatta Keyserling.

Epeira trivitatta is one of the orb weavers which constructs its web in low bushes, in swamp grass and in fence corners. It is a small spider and is often found in the same places as *Epeira domiciliorum*. Wild rose bushes and berry bushes are favorite places for these spiders to build their webs.

The color is usually brown, but varies a great deal and what I considered several distinct species in food determinations turned out to be but one after they were properly identified.

The web is of the complete orb type and is vertical or nearly so. It is a small web about twelve inches in diameter. When the web is built in a bush, the spider makes a retreat by pulling together several leaves, but when the web is made in grass the spider rests on the center of the hub awaiting its prey.

I counted thirteen of them on one rose bush (*Rosa carolina*), six feet by five feet. On another small bush I counted six. They are not as abundant as might be supposed from these figures, but one can almost always find one or two of them in a clump of bushes.

The insects used as food are wrapped up in a swathing band. The soft parts are eaten and the chitinous parts cast aside. The insect most often found in this spider's web was *Ceresa bubalus*. Next to *Ceresa bubalus*, *Lygus pratensis* was the most common one captured. *Draeculacephala mollipes* and nymphs of grasshoppers came in next. The other insects listed were only found occasionally.

Epeira domiciliorum Hentz.

Epeira domiciliorum and *Epeira trivitatta* are called varieties of the same species by Emerton. Professor Comstock makes two distinct species, naming one *Neoscona arabesca* and the other *Neoscona benjamini*.

The two spiders are found in the same situations, but *Epeira trivitatta* is the more abundant. The web is of the complete orb type and all of them observed made their webs in small bushes. This spider usually commences to build its

web a little while before sunset and finishes it before dark or a little after.

All of the individuals of this species observed made a retreat above the web by drawing together several leaves. A trap line extends from the retreat down which the spider goes very quickly if an insect falls into the web. *Epeira domiciliorum* remains in its retreat in the daytime, but at the approach of darkness it descends the trap line and stations itself in the hub of the web. Smaller individuals can be lured from the retreat in the daytime by casting an insect into the web, but I have never been able to get a full grown spider to come out of his hiding place in the daytime.

When an insect is captured, it is carried up the trap line to the retreat, where the juices are sucked out and the chitinous parts are discarded.

Epeira foliata Koch.

Epeira foliata is a spider which is common and is found around houses, barns and fences.

It is more abundant around houses than barns or fences. I have found a few specimens in a deep woods and on weeds, but they were by far the most abundant on houses.

The web is of the complete orb type and is made after night. A trap line sometimes extends from the web to a retreat, but this is not always the case. When the web is made on a house, there is no retreat constructed. A crevice under the siding is usually utilized for that purpose. The younger spiders construct their webs most anywhere on the house, but the larger ones prefer a situation near the water spouting, near a window or a corner of the house, where they can find a place to remain in hiding during the daytime. The larger spiders never come from their retreats during the daytime, the smaller ones will sometimes do so, but very seldom.. As soon as evening comes the spiders come forth from their places of hiding and station themselves on the center of the hub. Insects often become entangled in the webs during the daytime and the spider feeds upon them when evening comes. Many house flies become entangled in the morning and evening, when this spider is feeding. I have seen a cuckoo fly, *Chrysis parvula*, hunting for a place to deposit her eggs become entangled in this spider's web. She was unable to extricate herself and in the evening

the spider dispatched her summarily. Besides what they actually eat, these spiders destroy an enormous number of gnats and midges which become entangled in the webs at night. The webs of these spiders sometimes contain so many gnats that one cannot estimate their numbers.

When an insect gets into this spider's web, the spider proceeds from the hub and ties it up. Then it returns to the hub with the insect and begins sucking out the juices. If another insect is thrown into the web it ties this insect up and goes back and begins eating the one it was interested in before the second was thrown into the web. So with a second and third, usually returning to the insect it was feeding upon first.

Sometimes each insect will be carried along on the return to the hub and deposited with the insect first thrown into the web. Several times I amused myself by catching a great number of flies and throwing them into the web of this spider one at a time. The first one was usually taken back to the hub of the web, where the spider started to eat it. If a second fly was thrown into the web, the spider tied it up and returned to the center of the hub with it and placed it along side the first one and started eating again. If still another fly was thrown in, the spider repeated the performance. So on with the third and fourth. This was kept up until the spider had accumulated enough flies to make a small ball about the size of an English walnut. Unfortunately, this was too much weight for the strength of the web and it gave way. The spider had to build a new web, but I repeated the performance the next night and he seemed as greedy as ever. One point here, I think, is of some value. No matter how many insects fly or fall into the web, they are all killed. The number of insects from which the spider actually sucks the juice may be small in comparison to the number that are actually killed. In this case the good or bad accomplished by the spider cannot be judged by the number of insects that it actually eats. If the insect is injurious, as is most often the case, the number that is destroyed does not depend on the spider's capacity, but upon the abundance of the insect. Many spiders have the habit of tying up every insect that happens to get into their webs. Where such spiders are abundant we have found them more abundant than the non-net building species, they play an important role in keeping insects in check.

Epeira foliata was studied in two situations, the one along a fence and the other on a house. They were watched all summer upon the house where they were especially abundant. Early in the summer I counted one hundred and sixty-nine individuals on this one house. Most of them were near the ground, around the windows, spouting and porches, but some of the smaller ones were along the side of the house on the second story. I counted them frequently and found the number varied but slightly until the young began to hatch, late in the summer. The number increased to several times the one hundred and sixty-nine individuals, but the young were so small that it was impossible to count them accurately. However, I counted as many as five hundred individuals.

One would naturally suppose that the house fly, *Musca domestica*, would be the insect most often eaten in such a location and such was the case. Several half-grown spiders constantly made their webs in a bed of geraniums where they did good service in destroying a green aphid which infested these plants. The number that was used as food was but a small per cent of the number that was destroyed by becoming entangled in the web. Toward the close of the summer there were not very many of these aphids to be found. Although other factors may have entered to some extent into their extermination, I think it was largely due to these spiders. Besides these insects and a few moths, other insects flew into their webs occasionally.

Excepting the gnats and midges destroyed, because it was impossible to count them, the insects destroyed are rated as follows:

85% consisted of Musca domestica; 5% consisted of Aphids; 3% consisted of Lepidoptera; 7% all other insects.

I tried to make this spider eat the common firefly, *Photinus pyralis*, but never succeeded in getting one to try it. I think this may be due to the bitter taste this insect is supposed to have.

Epeira trifolium Hentz.

The Shamrock spider as this one is sometimes called is one of our largest spiders and also one of the most beautiful ones. This spider matures late in the summer and has a comparatively short feeding period since they all die before winter.

A variety of this species, *Aranea trifolium candicans*, was also studied.

Epeira trifolium makes a large complete orb web and places it preferably in tall grass, on Boneset stalks (*Eupatorium perfoliatum*), on Ironweed (*Vernonia gigantea*) or berry bushes. A retreat is made above the web by drawing together several leaves and making a tent. The leaves are pulled together in such a way as to make a retreat that is difficult to detect. A trapline extends from the retreat to the hub of the web and as soon as an insect gets into the web, the spider comes down the trapline, wraps up the insect in a swathing band and carries it up to the retreat where the soft parts are eaten and the chitinous parts are discarded. In case the spider does not want to eat the insect immediately she returns to her position in the retreat, leaving the insect tied up in the web where it became entangled.

Where one of these spiders has a web in a patch of Ironweeds or Boneset, many honey bees fly into the web which is vertical or nearly so. In such places, one frequently finds a web with a half dozen or more bees in it. A peculiar color adaptation was noticed in this spider. Early in the season all the individuals were either white without markings or grayish with white markings. Later in the season nearly all of them were of a reddish brown color and some were nearly purple. At first I concluded that this was due to the different ages of the spiders. Later on in the season I came upon a couple of instances which have changed my opinion. I found a large specimen which made its web in a clump of Bitter Sweet bushes. A retreat was made above the web in the dead leaves of a branch of an oak tree. The limb had fallen into the bush with the leaves still hanging on it. The spider lived here undisturbed a long time and became the same color as the dead oak leaves. Nowhere else did I find a spider of that peculiar color nor did I find any other spider having a retreat in dead oak leaves. If the environment had no effect on the color of the spider, one would have expected to find similarly colored individuals in other places. Why should this one spider become so nearly alike the retreat if the retreat did not exert an influence on the spider? Another question might be advanced here. Why should the spider change color if coloration were for protection or an aid in procuring food? The spider conceals itself in the retreat until some insect flies into the web and it seems that color resemblance

would not be needed for that purpose. Some credence might be given to the protective resemblance theory. A spider the same color as the leaves would not be discovered so easily by many of the spider's natural enemies. Another spider which had a retreat in a deep purple flower was the same color as the flower. These incidents cause me to believe that this spider responds to the color of its surroundings. The fact that most of them are white or grayish white early in the season and later most of them become reddish brown and purplish brown has some explanation. Early in the summer most of the wild flowers are white but later on in the fall Ironweed and purple asters are more in evidence in grassy and marshy places where this spider is most likely to construct its web. While this change may be due to the age of the spider, I am inclined to think it is a response to environment. The color change is so marked in different individuals of nearly the same size that one would suppose that some factor other than age entered into the color change. This color change may aid the spider somewhat in food getting but it is probably of more value as a protection against the numerous enemies of the spider.

Epeira trifolium was not as abundant as *Agelena nævia* and *Argiope riparia* but it was a common spider both at Crestline and Columbus. It is found in pasture lands which have been allowed to grow up in weeds, along roadsides, in bushes and most often in marshy places. As such places do not take up a definite area it is not easy to give a close estimate of the number on any given area. In a pasture field which I often visited one could count twenty to twenty-five of them on a half acre. These were in a patch of weeds and the rest of the field did not contain a dozen spiders because there was no weeds in which they could build their webs. It is fairly abundant in the places where it is likely to be found but these are restricted areas. The large size of the spider makes it an important one from the standpoint of food relations.

Many webs of this spider were observed and the spider's food is based on the contents of one hundred and forty-seven webs in which the spider was observed feeding.

22% contained honey bees; 20% contained grasshoppers; 8% contained Meloidæ, 6% of this 8% being Epicauta pennsylvanica; 7% contained Jassids; 6% contained Drasteria erechta and Drasteria crassiuscula; 6% contained Winged Ants; 4% contained Lygus pratensis;

3% contained Tipulidæ; 3% contained Sapromyza lupulinæ; 2% contained Coccinellidæ; 2% contained Bumble Bees; 2% contained Melanostoma mellinum; 9% all other Diptera not already included.

The highest per cent of any one insect fed upon by this spider was the honey bee. The reason for this is that *Epeira trifolium* does not mature until the first of August or about the time when the first fall wild flowers are in bloom. Such flowers as Golden Rod, Asters, Boneset and Ironweed all grow in places where this spider builds its web. The web is made vertical or nearly so and is often made between the stalks of two of these plants. The bees come to visit the flowers and get entangled in the web. Some of these flowers continue to bloom almost as long as the spider lives, so during their whole feeding period they are living in places where they can easily secure honey bees. I do not think they prefer bees to any other insect, but it is simply a question of the location of the web and the chance of bees flying into it. Grasshoppers are always abundant in the locations where this spider makes its web and forms the second highest per cent of the food of those observed. Nearly all the other insects which enter into the food to any extent are of an injurious character. To decide whether or not this spider is of an injurious or beneficial character several things must be considered. Whether a honey bee is of more value than the destruction of a grasshopper it is difficult to say. If we balance the insects destroyed which are injurious to farm crops against the honey bees and Coccinellidæ, we find that the higher per cent of insects destroyed are injurious ones. But the question would still remain as to what value should be given to honey bees and Coccinellidæ when they are rated against other insects. In my opinion the good they do overbalances the injury.

Epeira gigas Leach.

Epeira gigas is closely related to *Epeira trifolium*. Like *Epeira trifolium*, it is one of our most beautiful spiders. The color markings vary a great deal and Comstock gives three varieties of this same species. The color markings vary so much that one would mistake different individuals for different species. This spider is found in much the same situations as *Epeira trifolium*. However, it is more given to building its web in woods and bushes than is *Epeira trifolium*. It often makes its web in trees ten or fifteen feet from the ground.

The web is a complete orb and is more than a foot in diameter and it is built in a variety of places. One finds them in bushes, on shrubs, on weed stalks, such as Boneset and Ironweed and high up in trees. I have found them more abundant in deep woods than any place else. In one woods where they were especially abundant, they sought out the open places in the woods. This woods was exceedingly thick and somewhat marshy. In these open places were clumps of elderberry bushes, tall weeds and wild flowers. Some of the webs were attached to the elder bushes and some were high up in the trees. I have seen one side of the web tied to a tree two hundred or three hundred feet distant from the web. A retreat is built above the web and usually to one side of it by tying together several leaves and making a sort of tent. A trap line extends from the retreat to the center of the web and the spider descends this to the web and secures its prey. The spider remains in the retreat during the daytime, but comes out at night and takes a position in the center of the hub. When an insect flies into the web it is completely wrapped up by a swathing band. Like *Epeira trifolium*, this spider carries its prey up to the retreat, where the soft parts are eaten and the chitinous parts discarded. It wraps up any insect that chances to fly into the web, so the food depends to a large extent on the location of the web and the prevalence of any certain kind of insects.

This spider matures the last of August and so has a comparatively short feeding period. It was more abundant both at Crestline and at Columbus than *Epeira trifolium*, which has about the same feeding period. I counted the number in a woods of ten acres and noted eight hundred and ninety-six individuals. Nowhere else did I find them so abundant as in this one place. The woods was very thick and no stock of any kind had ever been allowed in it, so this spider had free range. Only 4% of this large number were found to be feeding or to have anything in their webs.

I counted them in other locations and found many of them on small areas. A clump of berry bushes is another location where one usually finds them in abundance. On one such clump of berry bushes, which was ten by fifteen feet there were fifteen of these spiders. In a grove of white ash trees on the edge of a wood several of these spiders built their webs about fifteen feet from the ground, and occasionally a web was suspended between two of the trees.

The percentage of insects used as food is based upon ninety-seven spiders which were observed feeding and is as follows:

20% consisted of Bumble Bees; 20% consisted of Tipulidæ; 17% consisted of other Diptera, chiefly Syrphidæ; 5% consisted of Grasshoppers; 5% consisted of Noctuid moths; 4% consisted of Lygus pratensis; 3% consisted of Apis mellifica; 4% consisted of Vespa germanica; 2% consisted of Vespa maculata; 2% consisted of Ichneumonidæ; 2% consisted of Jassids; 2% consisted of Ceresa bubalus; 2% consisted of Tiphia inornata.

A striking fact about the food of those spiders which were observed was that Bumble bees made up a large part of the food while the highest per cent of any insect eaten by its near relative, *Epeira trifolium*, was honey bees. This again is explained by the location of the webs. *Epeira trifolium* is more abundant among wild flowers in fields, while *Epeira gigas* made its web most often in open places, in woods and among shrubs. Crane flies, which are abundant in woods in late summer and fall, also formed a large part of the food. In such places Grasshoppers are less abundant and so formed a smaller per cent of the food than that of most other spiders. Syrphid flies were abundant in such a place and so entered into the food to a considerable extent. One would not expect many leaf hoppers in such a place and such is the case, only 2% of the food consisting of Jassids. Like the other large orb weaving spiders, the food of this spider where it has been observed is not relegated to any particular insect, but depends largely on what kind is at hand to be eaten.

Argiope trifasciata Forskal.

This spider has a number of names all of which are suggestive of the peculiar striped back. It was very abundant in the places where it was studied. The web is the common orb type and may or may not have barrier webs. It is of considerable diameter, usually from a foot to a foot and one-half from top to bottom, and is made vertically or slightly inclined. There are two or three types of stabilimentum and there may be no stabilimentum at all. In one type the stabilimentum reaches vertically through the web and is comparatively narrow. In another type which is not so common as the former the stabilimentum is irregular in shape being somewhat like a truncated cone narrowed at the base. Late in the season many webs do not have a stabilimentum. This is probably due to the fact

that at that time most of the webs are made by mature spiders. The stabilimentum is constructed in the young stages of this spider because the web is smaller and needs more support when a large insect gets entangled in it.

No trapline is made but she hangs head downward in the center of the hub. When a very large insect becomes entangled in the web this spider often makes a hasty retreat. Sometimes it drops to the ground and remains perfectly still until the danger is past then it goes back to the dragline it spun while descending and assumes its former position on the hub of the web. At other times especially when the web is made in big weeds or small bushes, it ascends the web and lies very still on top of a leaf for sometime when it again returns to its former position. Like *Argiope riparia*, this spider makes barrier webs on each side of the main web. Sometimes the barrier web is made on only one side of the web. These barrier webs are more loosely constructed than is the main one. Although I have no definite explanation for the barrier webs, I think they are constructed for keeping out very large insects. Often when an insect strikes the web of *Argiope trifasciata* the spider begins to swing the web until it vibrates very rapidly. I think this is done for two purposes. If the insect is a large one the spider can entangle it sufficiently so that it can wrap it up in a swath of silk when it once advances on it. But if the insect is so large that it is beyond the spider's control, the insect may flounder in the web and becomes entangled without any more serious damage than destroying the spider's home which can soon be reconstructed.

This habit varies greatly with different individuals of this species and sometimes it seemed to me they were trying to shake the insect out of the web. Sometimes this spider advances on a large grasshopper without an attempt at vibrating the web. Many times the victim was twice the size of the spider and was so quickly swathed in a white band of silk that the eye could scarcely register the movements and it was with difficulty that the web was pulled off the victim. It may be that this is a sign of fright as I have made them vibrate the web violently by merely approaching the web or casting something into it, but I hardly think this is a good explanation. When an insect flies into the web the spider rushes on it from its position on the center of the hub and sometimes pierces it with the

claws of the chelicerae but more often this is omitted, the spider advancing upon the insect and when it is nearly upon it, the spider pulls a swathing band from the spinnerets and thrusts this band against the insect with one of the hind legs. The swathing band is of considerable length and of considerable width. It changes from one hind leg to the other and so keeps the insect at a safe distance. When the swathing band has adhered sufficiently, it wraps the insect up. Sometimes the insect is too large and the spider is compelled to retreat. But very seldom is this the case for this spider is able to overpower an insect several times its size. Argiope seems to possess something which verges closely on what we term good judgment for it seems to know what sized insects it can readily dispose of and in case the insect is too large it drops to the ground by means of a dragline or ascends to a leaf until all danger has passed. But once it advances upon an insect the battle is on until the insect has been securely wrapped up. The male makes the same kind of a web as the female, but, considered from the standpoint of their food relations, they are less important because of their much smaller size and short life. I have often found several males on the barrier web of the female.

The great abundance of this spider is due to the kind of snare it makes enabling it to cope with a variety of conditions in securing food. The web is built close enough to the ground so as to capture a great variety of insects that have the habit of jumping from one place to another such as grasshoppers and crickets. It is also built at a sufficient height as to capture many insects that go from place to place by flying. Such a snare has the advantage over such flat webs as the Funnel Weaver's and the spider has a still greater advantage over those spiders which make no web at all.

The webs are constructed in a variety of places. A small patch of blue grass sixty feet by one hundred and twenty feet was literally covered with the webs of this spider. On the 14th of August I counted one hundred and forty-four young spiders in this grass patch. Webs were found in oats fields; sometimes the webs were made on oats shocks. Some were found in pasture fields but they were never found in abundance in fields where cattle or sheep were pastured. They were noted on brush piles and in woods where the trees were scattering but never in deep woods. They were most abundant in places where there was

an abundant growth of tall grass and weeds, especially along roadsides and fences and in orchards and clearings on wild rose bushes, on Boneset, and Ironweed. Much of the data was collected in ravines which were overgrown with bushes and weeds. In several ravines of this nature about two miles northwest of Columbus, *A. trifasciata* was very abundant. Clover fields and corn fields were adjacent to these ravines and they made a good place for the study of the food of this spider. In such places it was impossible to estimate the webs on any considerable area but it was not uncommon to find eight or ten webs in a distance of twenty-five feet.

In these ravines their food consisted chiefly of grasshoppers, tree crickets, Jassids, Membracidæ, Pentatomidæ, Coreidæ, Meloidæ, Tipulidæ and Noctuid moths. In the patch of blue grass mentioned 80% of the food consisted of grasshoppers. In the young stages of this spider most of the webs are made in the grass and grasshoppers constitute their chief food. The grasshoppers are captured in the nymph stage and destroyed before they have an opportunity of doing a great deal of damage. In such places their food consists almost wholly of injurious insects. In patches of Boneset, Ironweed and similar weeds which bloom in late summer or fall the food supply is largely honey bees, bumble bees and other Hymenopterous insects which visit these flowers and become entangled in the web of this spider. They have no decided preference for any insect so far as I have observed and the food supply is determined largely by the insects which are prevalent in the places where the web is made. Since the majority of webs are constructed in places where insects which are injurious to farm crops will be entangled, I think this spider is of value from an economic standpoint. These spiders were first noted in abundance the first of August. They were very small at this time and made their small orb webs near the ground in the grass. The last ones were noted November 4th at Columbus. After this date it was impossible to find any females. The winter is passed in the cocoon, the young spiderlings emerging in the summer. The large size of the spider and the long feeding period are factors of importance in considering its value. If people who are always so willing to crush any spider they see either through ignorance or through superstition would study this beautiful creature for a short time they would soon see they

were destroying a creature of considerable value to themselves. In my studies I have handled hundreds of these spiders and have not been bitten once.

The per cent of each particular class of insects is based on the contents of six hundred and twenty-one webs of this spider is as follows:

44½% consisted of Grasshoppers; 9% consisted of Jassidæ; 9% consisted of Tipulidæ; 6½% consisted of Eurymus philodice; 5% consisted of Apis mellifica; 4% consisted of Pentatomidæ; 4% consisted of Epicauta pennsylvanica; 3½% consisted of Capsidæ; 3% consisted of Oecanthus niveus; 1% consisted of other spiders.

Like its near relative, *Argiope riparia*, this spider feeds mainly on grasshoppers; nearly half of its food consisting of that insect. The percentage of honey bees eaten is much less than that of *Argiope riparia*. This is due to two things. *Argiope riparia* matures earlier in the season and has more nearly attained its growth when the fall wild flowers begin to bloom. It thus has more opportunity of capturing bees when they visit these flowers. *Argiope trifasciata*, at least those observed, spent the earlier part of their lives in grass and there is little opportunity of capturing bees in grass. By the time it has matured sufficiently to construct a large web some of the flowers are gone and there is less chance of bees getting in the web. Nearly all of the Jassids eaten were one species, *Dræculacephala mollipes*. The Pentatomidæ taken from the webs were of several species, the one most often found being *Euchistus variolarius*. This spider was observed eating more spiders than any other spider. *Agelena nævia*, *Phidippus audax* and *Argiope trifasciata* themselves being the ones eaten. I think this was likely due to the fact that this spider lives late in November when insect life gets scarce and the opportunity for capturing spiders greater.

As far as I have observed, the cannibalistic habit is not so much developed as is generally thought to be the case in most spiders. I have observed several different species of spiders which feed on other spiders but none of them to any great extent until late in the fall when other food becomes scarce. One spider, *Xysticus gulosus*, which was very plentiful late in the fall and which I found most abundant on fence posts seemed to be given to much cannibalism. Sometimes there were three or four of these spiders on one post. Frequently one or more of

them was eating some other small spider, *Philodromous vulgaris*, most often being the victim.

I have seen *Argiope riparia* and *Agelena nævia* occasionally eating one of their own species or some other spider but this practice as far as I have observed is not so common as is generally thought to be the case. One can pen a couple of spiders of some species up in a box together and if one keeps them supplied with food they live together peaceably. If food is not supplied they take to the cannibalistic habit and the weaker one becomes the victim of the larger. I had a *Dolomedes tenebrosus* penned in a small box for sometime and neglected to feed it for a few days. It became hungry and devoured the contents of its own egg sac which it had been carrying around for several days. In another box I kept two individuals belonging to *Lycosa avida*. One of these was much larger than the other but they got along very well for some time. One evening I dropped a large fly between them and both of them jumped to get it. The smaller one was the quicker and got the fly first, but the larger spider was not to be outdone so he pounced on the smaller one and killed it, and the fly besides, and ate the fly and the head of his cage-partner. Since 83% of the food of the spiders observed consisted of insects injurious to crops, I think this spider should be considered of some benefit to the agriculturist. It takes a toll of a few honey bees for the good it accomplishes but in this case the percentage of honey bees is not high, being only 5%.

Argiope riparia Hentz.

Argiope riparia, because of its large size and bright coloring, is perhaps the best known of all of our common spiders. Where this spider has been studied it has been more abundant than any other spider except *Agelena nævia*. The web is very large, often being more than two feet in diameter. The web is either vertical or a little inclined and the spider when at rest stations itself in the center of the hub. It has the peculiar habit of making a small "clearing" when about to make its web in thick tall grass. This is done by drawing aside the grass around a central point in which the web is to be made. In this way the web is not so easily injured by tall grass swaying into it. And again when insects become entangled in the web and attempt to escape, they are less liable to be able to get hold of some-

thing which may help them to extract themselves. This species like Metargiope, usually but not always builds a barrier web on each side of the main one. Like *Argiope trifasciata*, to which it is closely related, it makes the web firm by a stabilimentum which extends vertically through the center of the web.

The webs are built in a great variety of places but are preferably built in tall grass and among weeds. I have found webs of this species in barns, in hay mows, and one in the cone of the roof of an old log house where the spider was content to remain for a month. Some are built in grain fields and a great many in pastures. The webs are most abundant along ditches which are overgrown with tall grass and weeds; and along fences and in pasture land which has been allowed to become overgrown with Boneset, Ironweed and similar plants and along roadsides which have become overgrown with golden rod and asters. In order to gain an estimate of the numbers of these spiders, counts were made in these various locations and repeated from time to time.

Soon after the appearance of these spiders in early summer, I counted the webs of thirty-six individuals on a single wild rose bush, which measured ten by sixteen feet. The webs were so numerous that often one which was built near the ground was directly under another farther up in the bush. Such bushes as this one seems to be one of the favorite places for the home of this spider. At another place fourteen spiders were counted in a fence corner which was sixteen feet long and four feet deep. This was an exceptionally large number, but it is given to show how numerous this spider is in some places. Along this rail fence in a distance of thirty rods, one hundred and fifty-six spiders were counted. A pasture field which bordered a woods and contained one and one-half acres, was visited daily for several weeks. This field was covered with tall grass, Boneset and Ironweed. The spiders seemed to show a preference for building their webs between Boneset stalks and on this account many honey bees were captured. In making the count in this place I walked up and down across it, taking a small strip each time, about three feet wide. It will be seen that an accurate account of a web-building species could be obtained in this way which would be impossible in case of the Lycosids and other species which wander from place to place. One count taken here gave one hundred and forty spiders. Another count taken later on

in the season gave one hundred and fifty-seven individuals. This number will seem to be a little inconsistent with the number given for a small area. The reason is that cattle and hogs were pastured here. Where cattle were allowed to pasture the spiders gradually left and moved to a field where they were undisturbed.

Observations were made along a public road for a distance of sixty rods. The distance from the ditch along the side of the road to the fence varied from two to three feet. This space was overgrown with golden rod, blackberry bushes, timothy and asters. In this distance three hundred and twenty-two individuals were counted. The number was counted several times, but remained fairly constant. It is seen that these spiders are very abundant in a great variety of places. The fact that they are of a large size and very abundant makes them of some importance from the standpoint of their feeding habits. The position of the web has a great deal to do with the food eaten. Webs of *Argiope riparia* are placed in so many situations that a great variety of insects is captured. The vertical position of the web aids in capturing any kind of insect that happens to be moving in its path. The spider waits for its prey on the center of the hub and does not build a retreat. When an insect becomes entangled in the web it advances upon it, pulls out a swathing band and thrusts this against the insect. The spider changes from one hind leg to the other just as *Argiope trifasciata* does and so keeps the insect at a safe distance. Sometimes the insect is pierced with the chelicerae, but often this is not the case. The spider merely wraps it up to await the time when it is needed as food. Many insects were taken from webs and kept a day before the swathing band was removed. Often the insect was alive when the band was taken off which would not have been the case had the spider pierced it with the chelicerae. The insect is always wrapped so tightly that it cannot make any resistance nor injure the web after it has once been enswathed. In case the insect is too large the spider drops to the ground by means of a dragline or else ascends to some leaf where it lies very quiet until the danger is past, when it returns to its former position on the hub of the web. This spider also makes barrier webs similar to *Argiope trifasciata*.

The first *Argiope riparia* was recorded at Crestline on July 4th. It was about one-third grown at this time. I began to record them in greater numbers soon after this time. They emerge from the egg-sac much before this, but are so small that they are seldom noticed. The last ones were recorded on October 21st, at Columbus. All the data given on the number of spiders and the amount of food eaten was gathered on an area of about forty acres. As far as we have observed, *Argiope riparia* will feed upon any kind of insects. A few times I have seen them cut the common firefly, *Photinus pyralis*, loose from the web and cast it aside. They do this sometimes with other insects, such as wasps, when there is a sufficient supply of grasshoppers. The places and manner of constructing their webs have accustomed them to feeding upon a great variety of insects. This wide range of food habits is one of the factors which accounts for their prevalence. We had hoped to see what influence these spiders would have in the control of the Chinch Bug, *Blissus leucopterus*, but unfortunately the cold continuous rainy weather in early summer nearly wiped out this pest in the vicinity where they were very destructive the year previous. A few chinch bugs were found in the webs early in the summer, but the rainy weather so completely killed them off that when the spider had attained any considerable size, there was scarcely a chinch bug to be found.

When *Argiope's* web was constructed in meadows and pastures it fed chiefly on grasshoppers, Capsids, Jassids, *Phytonomus punctatus*, Lepidoptera, chiefly *Eurymus philodice* and other insects injurious to grasses. If the webs were in shrubbery, Membracidæ, Oecanthus and grasshoppers were eaten. A great many webs were constructed on and near the wild flowers and weeds and in those cases honey bees and blister beetles were the principal toll. An area was selected which would be representative of a variety of food conditions. In this area were a great many Boneset and Ironweed stalks. When these came into bloom they were frequented by honey bees and it is because of this that the percentage of honey bees is so high. If the records had been taken from pastures only, the percentage of honey bees would have been very small. Again, if an area with only Boneset bushes and Ironweed stalks had been included, the percentage of honey bees would have been much higher. The tract of land referred to embraced a couple

of pasture fields, a small tract on the edge of a woods which was entirely cleared of brush piles, etc., and which was for many years seeded to blue grass. A creek traversed the tract and this was overgrown with weeds, grass and small bushes. Part of it was covered with scattering trees. In this part were many piles of brush and rubbish; in another part of it was a young Catalpa grove which was seeded to blue grass. It will thus be seen that a variety of conditions was obtained.

Insects common to different conditions would be entrapped and a list of such insects are given. Not all the insects could be identified, especially some of the smaller ones which were badly broken up. Only the juices are sucked from the insect, after which it is cut loose from the web and thrown out to the ground. Argiope wraps up practically every insect that happens to strike the web. Webs were noted in which there were two or three grasshoppers, a Capsid and a locust tree borer all at the same time. Many times she has her web checkered with a half-dozen insects, yet if another insect strikes her web she goes at once to the place and ties it up. One often finds deserted webs with several insects in them which have not been eaten. Many times the insects which are captured are much larger than the spider herself.

The observations on the food of this spider took in the entire feeding time of the spider and extended over a period of about four months. During that time data was taken on two thousand two hundred and forty-nine individuals and the percentages of the insects used as food are based on the webs of one thousand two hundred and fifty spiders.

35% of the webs contained grasshoppers; 14% contained Apis mellifica; 9% contained Epicauta pennsylvanica; 5% contained Lygus pratensis; 4% contained Drasteria erechta and Drasteria crassiuscula; 4% contained Ceresa bubalus; 3% contained Coccinella 9-notata; 2% contained Epicauta vitatta; 2% contained Jassids; 2% contained Phytonomus punctatus; 2% contained Tiphia inornata; 2% contained Onthophagus hecate; 1% contained Cyllene robinæ.

This spider's food includes a large variety of insects. It is a voracious feeder. The large size of the spider and the fact that only the juices are sucked are important facts because a large number of insects are destroyed by one spider in a limited time. One of these spiders, a very large one which I watched for a long time and whose food because of the situation of the

web consisted chiefly of grasshoppers, sucked the juice from five full-grown grasshoppers in a week. Some of these grasshoppers were larger than the spider itself. If on the two and one-half acre tract mentioned the spiders fed on grasshoppers entirely for one week and each destroyed five, there would be seven hundred grasshoppers destroyed each week. This is a high estimate perhaps because some spiders smaller than the one referred to would not eat that number in a week's time. But if the number were much less than seven hundred it is seen that they would be of a considerable aid in keeping down insects. 64% of the insects destroyed were of an injurious character; 19% were of a beneficial nature, and 2% were neither injurious nor beneficial to farm crops. The other 15% represented a varied number of different insects, a few of which were beneficial but the majority of which have no direct bearing either way as regards farm crops.

TABLE SHOWING INSECTS FED UPON.

x—insect eaten.
c—insect was eaten in cage.
w—insect was killed in web.
f—insect was eaten in the field.

Order	Lycosidæ			Attidæ		Clubionidæ	Thomisidæ	Pisauridæ	Dictynidæ	Agelenidæ	
	Lycosa avida	Lycosa carolinensis	Lycosa latifera	Phidippus audax	Phidippus podagrosus	Castianeria descripta	Misumena vatia	Dolomedes tenebrosus	Dictyna frondea	Agelena naevia	Coras medicinalis
ODONATA											
Agrion, sp.	.....	.....	.....	.....	.....	.....	.....	.....	.....	x-f	.....
ORTHOPTERA.											
Ischnoptera pennsylvanicus	x-c	.....	x-c	x-f-c	.....	.....	.....	.....	.....	.....	x-c
Orchelimum nigripes	x-c	.....	.....	x-c	.....	.....	.....	.....	.....	.....	.....
Scudderia furcata	x-c	.....	.....	.....	.....	.....	.....	.....	.....	x-f-w	.....
Melanoplus bivittatus	x-c	x-c	x-c	x-c	.....	.....	.....	x-c	.....	x-f-w	x-c
Melanoplus differentalis	x-c	x-c	x-c	x-f	.....	.....	.....	x-c	.....	x-f-w	x-c
Gryllus abbreviatus	x-c	x-c	x-c	x-c	x-c	.....	.....	x-c	.....	x-f-w	x-c
Oecanthus niveus	x-c	x-c	.....	x-c	x-c	.....	.....	x-c	.....	.....	x-c
Oecanthus fasciatus	x-c	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Cyrtophyllus concavus	.....	.....	x-c	.....	.....	.....	.....	.....	.....	.....	.....
Scudderia curvicauda	.....	.....	x-c	.....	.....	.....	.....	.....	.....	.....	.....
Melanoplus femur-rubrum	.....	.....	x-c	.....	.....	.....	.....	.....	.....	.....	.....
Dissosteira carolina	.....	x-c	.....	.....	.....	.....	.....	.....	.....	x-f-w	.....
Microcentrum retinerva	.....	.....	.....	.....	.....	.....	.....	.....	.....	x-f-w	.....
Orchelimum vulgare	.....	.....	.....	.....	.....	.....	.....	x-c	.....	.....	.....
Xiphidium brevipennis	.....	.....	.....	.....	.....	.....	.....	x-c	.....	x-f-w	.....
Encoptolophus sordidus	.....	.....	.....	.....	.....	.....	.....	.....	.....	x-f-w	.....
HEMIPTERA.											
Miris dolobratus	x-c	.....	x-c	x-c	.....	.....	.....	.....	.....	x-f-w	.....
Miris amoenus	x-c	.....	.....	.....	.....	.....	.....	.....	.....	x-f-w	x-c
Adelphocoris rapidus	x-c	.....	x-c	x-c	.....	x-c	.....	x-c	.....	.....	.....
Lygus pratensis	x-c	x-c	x-c	x-f	x-c	x-c	x-f	x-c	.....	x-f-w	x-c
Macrotylus lineolatus	x-c	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Lopidea confluenta	x-c	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Nabis ferus	x-c	x-c	.....	.....	x-c	.....	.....	x-c	.....	x-f-w	x-c
Kolla bifida	x-c	.....	.....	.....	.....	x-c	.....	.....	.....	.....	.....
Cicadula 6-notata	x-c	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Phlepsius irroratus	x-c	.....	.....	x-c	.....	x-c	.....	x-c	.....	x-f-w	x-c
Graphocephala coccinea	x-c	.....	.....	.....	.....	x-c	.....	.....	.....	.....	.....
Draeculacephala mollipes	x-c	.....	.....	x-c	x-c	x-c	.....	x-c	.....	x-f-w	.....
Ormenis septentrionalis	x-c	.....	.....	.....	.....	.....	.....	.....	.....	x-f-w	.....
Cicada linnei	.....	x-c	.....	.....	.....	.....	.....	.....	.....	.....	.....
Macrotylus amoenus	.....	.....	.....	x-c	.....	.....	.....	.....	.....	.....	.....
Poecilocapsus lineatus	.....	.....	.....	x-c	.....	.....	.....	.....	.....	.....	x-c
Bruchomorpha dorsata	.....	.....	.....	x-c	.....	.....	.....	.....	.....	.....	.....
Deltocephalus inimicus	.....	.....	.....	.....	x-c	.....	.....	.....	.....	x-f-w	.....
Ceresa bubalus	.....	.....	.....	x-c	.....	.....	.....	.....	.....	x-f-w	.....
Campylenchia curvata	.....	.....	.....	x-c	.....	.....	.....	.....	.....	x-f-w	.....
Enchenopa binotata	.....	.....	.....	x-c	.....	.....	.....	.....	.....	.....	.....
Deltocephalus inimicus	.....	.....	.....	.....	.....	.....	.....	.....	.....	x-f-w	.....
Phymata wolffi	.....	.....	.....	.....	.....	.....	.....	.....	.....	x-f-w	.....
Acrosternum hilaris	.....	.....	.....	.....	.....	.....	.....	.....	.....	x-f-w	.....
Acanalonia bivitatta	.....	.....	.....	.....	.....	.....	.....	.....	.....	x-f-w	.....
Jassidæ, sp. undetermined	.....	.....	.....	.....	.....	.....	x-f	.....	x-f	.....	.....
NEUROPTERA.											
Chrysopa oculata	.....	x-c	x-c	x-c	.....	.....	.....	.....	.....	.....	.....

TABLE SHOWING INSECTS FED UPON.
(Continued.)

Order	Lycosidæ			Attidæ		Clubionidæ	Thomisidæ	Pisauridæ	Dictynidæ	Agelenidæ	
	Lycosa avida	Lycosa carolinensis	Lycosa fatifera	Phidippus audax	Phidippus podagrosus	Castianeria descripta	Misumena vatia	Dolomedes tenebrosus	Dictyna frondea	Agelena naevia	Coras medicinalis
Lepidoptera.											
Drasteria erechta	x-c	x-c	x-c	x-c	.....	.....	.....	.....	.....	x-f-w	.....
Drasteria crassuiscula	x-c	x-c	.....	.....	.....	.....	.....	.....	.....	x-f-w	.....
Haematopsis grataria	x-c	.....	.....	x-c	.....	.....	.....	.....	.....	.....	.....
Pieris rapæ	x-c	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Pieris rapæ, larvæ	x-c	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Anosa plexippus, larva	x-c	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Spilosoma virginica	.....	.....	.....	x-c	.....	.....	.....	.....	.....	.....	.....
Heliophilus unipunctata	.....	.....	.....	.....	.....	x-c	.....	.....	.....	.....	.....
Arctia nais	.....	.....	.....	.....	.....	.....	.....	.....	.....	x-f-w	.....
Estigmene acraea	.....	.....	.....	.....	.....	.....	.....	.....	.....	x-f-w	.....
Apantesis nais	.....	.....	.....	.....	.....	.....	.....	.....	.....	x-f-w	.....
Mamestra picta, larvæ	.....	.....	.....	.....	.....	.....	.....	.....	.....	x-f-w	.....
Diptera.											
Eristalis transversus	x-c	.....	.....	.....	.....	.....	x-f	.....	.....	.....	.....
Mesograpta marginata	x-c	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Eristalis tenax	x-c	x-c	x-c	.....	.....	.....	.....	.....	.....	.....	.....
Heliophilus latifrons	x-c	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Melanostoma mellinum	x-c	x-c	.....	.....	.....	.....	.....	.....	.....	x-f-w	.....
Allograpta obliqua	x-c	.....	.....	x-c	.....	.....	.....	.....	.....	.....	.....
Haematobia serrata	x-c	.....	.....	x-c	.....	.....	x-f	.....	x-f	.....	x-c
Lucilia caesar	.....	.....	x-c	.....	.....	.....	.....	x-c	.....	x-f-w	.....
Musca domestica	x-c	x-c	x-c	x-c	x-c	x-c	x-f	x-c	.....	x-f-w	.....
Pseudopyrellia cornicina	x-c	x-c	.....	.....	x-c	.....	x-f	.....	.....	x-f-w	.....
Tabanus sulcifrons	x-c	.....	.....	x-c	.....	.....	.....	.....	.....	x-f-w	.....
Tabanus lineolatus	.....	x-c	.....	.....	.....	.....	.....	.....	.....	.....	.....
Sapromyza lupulinæ	x-c	.....	.....	x-c	x-c	x-c	.....	x-c	.....	x-f-w	x-c
Tipula flavicans	x-c	x-c	x-c	.....	.....	.....	.....	.....	.....	x-f-w	x-c
Tipula abdominalis	x-c	.....	.....	x-c	.....	.....	.....	.....	.....	x-f-w	.....
Promachus vertebratus	x-c	x-c	x-c	.....	.....	.....	.....	.....	.....	.....	.....
Leptogaster murinus	x-c	.....	.....	.....	.....	.....	.....	.....	.....	.....	x-c
Anthrax lateralis	.....	.....	x-c	.....	.....	.....	.....	.....	.....	.....	.....
Mesograpta polita	.....	.....	.....	.....	x-c	x-c	.....	x-c	.....	.....	x-c
Sarcophaga carnaria	.....	.....	.....	x-c	.....	.....	.....	.....	.....	.....	.....
Asilus antimachus	.....	.....	.....	x-c	.....	.....	.....	.....	.....	.....	.....
Promachus bastardii	.....	.....	.....	x-c	.....	.....	.....	.....	.....	.....	.....
Psilopodinus sipho	.....	.....	.....	.....	x-c	.....	.....	x-c	.....	.....	.....
Holomyza plumata	.....	.....	.....	.....	.....	x-c	.....	.....	.....	.....	.....
Sapromyza philadelphica	.....	.....	.....	.....	.....	.....	.....	.....	.....	x-f-w	.....
Pachyrhina ferruginea	.....	.....	.....	.....	.....	.....	.....	.....	.....	x-f-w	.....
Tipula trivitatta	.....	.....	.....	.....	.....	.....	.....	.....	.....	x-f-w	.....
Culex pipiens	.....	.....	.....	.....	.....	.....	.....	.....	.....	x-f-w	.....
Oncodes costalis	.....	.....	.....	.....	.....	.....	.....	.....	.....	x-f-w	.....
Tabanus costalis	.....	.....	.....	.....	.....	.....	.....	.....	.....	x-f-w	.....
Anthomiidæ; sp	.....	.....	.....	.....	.....	.....	.....	.....	x-f	x-f-w	x-c
Dolichopodidæ	x-c	.....	.....	.....	.....	.....	x-f	.....	x-f	.....	.....
Syrphidæ sp. undertermined	.....	.....	.....	.....	.....	.....	x-f	.....	.....	.....	.....
Scatophagidæ, sp. undeter	.....	.....	.....	.....	.....	.....	x-f	.....	.....	.....	.....
Asilidæ, sp. undetermined	.....	.....	.....	.....	.....	.....	x-f	.....	.....	.....	.....
Chironomidæ, sp. underter	.....	.....	.....	.....	.....	.....	.....	.....	x-f	.....	.....
Culicidæ, sp. undetermined	.....	.....	.....	.....	.....	.....	.....	.....	x-f	.....	.....
Coleoptera.											
Coccinnella, 9-notata	.....	x-c	.....	.....	.....	.....	.....	.....	.....	.....	.....
Coccinnella, sp. undeter	x-c	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Lachnosterna, larva	x-c	x-c	.....	.....	.....	.....	.....	.....	.....	.....	.....
Tetraopes tetraophthalmus	x-c	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Crotoparis lunatus	x-c	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Podarus rugulosus	x-c	.....	.....	.....	.....	.....	.....	.....	.....	x-f-w	.....
Elateridae, larvæ	x-c	x-c	.....	.....	.....	.....	.....	.....	.....	.....	.....
Ludia attenuatus, larvæ	x-c	x-c	x-c	.....	.....	.....	.....	.....	.....	.....	.....
Epicauta pennsylvanicus	x-c	x-c	.....	.....	.....	.....	.....	.....	.....	x-f-w	.....

TABLE SHOWING INSECTS FED UPON.
(Continued.)

Order	Lycosidæ			Attidæ		Clubionidæ	Thomisidæ	Pisauridæ	Dictynidæ	Agelenidæ	
	Lycosa avida	Lycosa carolinensis	Lycosa latifera	Phidippus audax	Phidippus podagrosus	Castianeria descripta	Misumena vatia	Dolomedes tenebrosus	Dictyna frondea	Agelena naevia	Coras medicinalis
COLEOPTERA (Continued)											
Cucujus clavipes, larvæ	x-c	x-c	x-c								
Tenebrio molitor, larvæ		x-c	x-c								
Chlaenius sericaeus			x-c								
Megilla maculata										x-f-w	
Chauliognathus pennsylvanicus										x-f-w	
Rhynchites bicolor										x-f-w	
Melanotus communis	x-c										
HYMENOPTERA.											
Larvæ, undetermined	x-c										
Pupæ, undetermined	x-c										
Myrmicidæ, sp	x-c				x-c						
Colletes, sp	x-c			x-c		x-f					
Agapostemon splendens	x-c									x-f-w	
Tiphia inornata	x-c	x-c	x-c	x-c						x-f-w	
Bombus americanorum	x-c										
Megachile infragilis			x-c								
Vespa germanica			x-c	x-f							
Vespa arenaria				x-c							
Vespa diabolica				x-c							
Vespa maculata				x-c							
Augochlora viridulus				x-c							
Augochlora fervidus				x-c							
Adrena, sp. undetermined				x-c			x-f				
Chrysis parvula										f-x-w	
Camponotus pennsylvanicus										f-x-w	
OTHER SPIDERS EATEN:											
Aranea thaddeus										f-x-w	
Agelena naevia										f-x-w	
Argiope riparia											x-f-w
Lycosa avida	x-f										

TABLE SHOWING INSECTS FED UPON.
(Continued.)

Order	Epeiridæ								
	Metepeira labyrinthea	Lecauge venusta	Epeira trivittata	Epeira domiciliorum	Epeira foliata	Epeira trifolium	Epeira gigas	Argiope trifasciata	Argiope riparia
Odonata.									
Diplax obtusa	.....	.....	x-w-f	.....	.....	.....	.....	.....	.....
Orthoptera.									
Melanoplus differentialis	.....	x-w	x-w-f	x-w-f	.....	.....	.....	x-w-f	x-w-f
Melanoplus bivitattus	.....	.....	x-w-f	.....	.....	.....	x-w-f	x-w-f	x-w-f
Xyphidium brevipennis	.....	x-w	.....	.....	.....	x-w-f	x-w-f	x-w-f	.....
Gryllus abbreviatus	.....	x-w	x-w-f	.....	.....	x-w-f	.....	x-w-f	.....
Oecanthus fasciatus	.....	.....	.....	.....	.....	.....	.....	x-w-f	x-w-f
Oecanthus niveus	.....	x-w	x-w-f	.....	.....	x-w-f	x-w-f	x-w-f	x-w-f
Encoptolophus sordidus	.....	.....	.....	.....	.....	x-w-f	.....	x-w-f	.....
Melanoplus femur-rubrum	.....	.....	.....	.....	.....	.....	x-w-f	x-w-f	.....
Microcentrum retinerva	.....	.....	.....	.....	.....	.....	x-w-f	x-w-f	.....
Amblycorpha oblongifolia	.....	.....	.....	.....	.....	.....	x-w-f	.....	.....
Scudderia furcata	.....	.....	.....	.....	.....	.....	.....	x-w-f	.....
Orchelimum vulgare	.....	.....	.....	.....	.....	.....	.....	x-w-f	x-w-f
Scudderia texensis	.....	.....	.....	.....	.....	.....	.....	x-w-f	.....
Hemiptera.									
Nabis ferus	x-w-f	.....	x-w-f	x-w-f	.....	x-w-f	.....	.....	x-w-f
Bruchomorpha dorsata	x-w-f	.....	x-w-f	.....	x-w-f	.....	.....	.....	.....
Graphocephala coccinea	.....	x-w-f	x-w-f	.....	.....	.....	x-w-f	x-w-f	.....
Draeculacephala mollipes	x-w-f	x-w-f	x-w-f	x-w-f	x-w-f	x-w-f	x-w-f	x-w-f	x-w-f
Kolla bifida	.....	x-w	x-w-f	.....	.....	.....	.....	.....	x-w-f
Ceresa bubalus	x-w-f	.....	x-w-f	.....	.....	x-w-f	x-w-f	x-w-f	x-w-f
Stenodema vicinum	x-w-f	.....	.....	.....	.....	.....	.....	.....	.....
Lygus pratensis	x-w-f	x-w	x-w-f	x-w-f	.....	x-w-f	x-w-f	x-w-f	x-w-f
Poecilocytus basalis	.....	x-w	.....	.....	.....	.....	.....	.....	.....
Horcias dislocatus var goniphorus	.....	x-w	.....	.....	.....	.....	.....	.....	.....
Miris amoenus	.....	x-w	.....	.....	x-w-f	.....	.....	.....	.....
Miris dolobratus	.....	.....	x-w-f	.....	.....	.....	.....	.....	x-w-f
Adelphocorus rapidus	.....	x-w	x-w-f	.....	.....	x-w-f	x-w-f	x-w-f	.....
Deltocephalus inimicus	.....	x-w	.....	.....	.....	.....	.....	.....	.....
Ormenis septentrionalis	.....	x-w	x-w-f	x-w-f	x-w-f	.....	.....	.....	x-w-f
Phymata wolffi	.....	.....	x-w-f	.....	.....	.....	x-w-f	.....	.....
Cicadula punctifrons	.....	.....	x-w-f	.....	.....	.....	.....	.....	.....
Cicadula, 6-notatta	.....	.....	x-w-f	.....	.....	.....	.....	.....	.....
Phlepsius irroratus	.....	.....	x-w-f	.....	.....	.....	x-w-f	.....	.....
Podisus maculiventris	x-w-f	.....	.....	x-w-f	.....	.....	.....	x-w-f	x-w-f
Aphididæ, sp. undetermined	.....	.....	.....	.....	x-w-f	.....	.....	.....	.....
Euthochtha galeator	.....	.....	.....	.....	.....	.....	x-w-f	x-w-f	x-w-f
Hymenarcys nervosa	.....	.....	.....	.....	.....	.....	.....	.....	x-w-f
Cosmopepla bimaculata	.....	.....	.....	.....	.....	.....	.....	x-w-f	x-w-f
Mormidea lugens	.....	.....	.....	.....	.....	.....	.....	.....	x-w-f
Acrosternum hilaris	.....	.....	.....	.....	.....	.....	.....	x-w-f	x-w-f
Brochymena annulata	.....	.....	.....	.....	.....	.....	.....	x-w-f	.....
Euchistus tristigmus	.....	.....	.....	.....	.....	.....	.....	.....	x-w-f
Euchistus variolarius	.....	.....	.....	.....	.....	.....	.....	x-w-f	x-w-f
Peribalus limbolarius	.....	.....	.....	.....	.....	.....	.....	x-w-f	x-w-f
Acanthocephala terminalis	.....	.....	.....	.....	.....	.....	.....	x-w-f	x-w-f
Alydus eurinus	.....	.....	.....	.....	.....	.....	.....	x-w-f	.....
Anasa tristis	.....	.....	.....	.....	.....	.....	.....	x-w-f	.....
Campylenchia latipes	.....	.....	.....	.....	.....	.....	.....	x-w-f	x-w-f
Nabis subcoleopterus	.....	.....	.....	.....	.....	.....	.....	.....	x-w-f
Acanalonia bivitatta	.....	.....	.....	.....	.....	.....	.....	.....	x-w-f
Neuroptera.									
Chrysopa oculata	.....	.....	x-w-f	.....	.....	.....	.....	.....	.....
Lepidoptera.									
Haematopia grataria	.....	x-w	x-w-f	.....	.....	.....	.....	.....	.....
Halisidota caryæ, larva	.....	.....	x-w-f	x-w-f	.....	.....	.....	.....	.....
Drasteria erechta	.....	.....	.....	x-w-f	x-w-f	x-w-f	x-w-f	x-w-f	.....

TABLE SHOWING INSECTS FED UPON.
(Continued.)

Order	Epeiridæ								
	Metepeira labyrinthea	Lecauge venusta	Epeira trivitatta	Epeira domiciliorum	Epeira foliata	Epeira trifolium	Epeira gigas	Argiope trifasciata	Argiope riparia
Diptera (Continued)									
Eurymus philodice	.....	.....	.....	x-w-f	.....	.....	.....	x-w-f	x-w-f
Pieris rapæ	.....	.....	.....	.....	.....	.....	.....	x-w-f	x-w-f
Apantesis nais	.....	.....	.....	x-w-f	.....	.....	.....	.....	.....
Drasteria crassiuscula	.....	.....	.....	.....	.....	x-w-f	x-w-f	x-w-f	.....
Vanessa atlanta	.....	.....	.....	.....	.....	x-w-f	.....	.....	x-w-f
Basilarchia archippus	.....	.....	.....	.....	.....	.....	x-w-f	.....	.....
Phyciodes nycteis	.....	.....	.....	.....	.....	.....	.....	x-w-f	.....
Tolype vedella	.....	.....	.....	.....	.....	.....	.....	x-w-f	.....
Pamphilia peckius	.....	.....	.....	.....	.....	.....	.....	x-w-f	.....
Euphyes metacomet	.....	.....	.....	.....	.....	.....	.....	.....	x-w-f
Diptera.									
Sapromyza lupulinæ	x-w-f	x-w	x-w-f	.....	.....	x-w-f	.....	.....	.....
Culex pipiens	x-w-f	x-w	.....	x-w-f	x-w-f	x-w-f	x-w-f	.....	.....
Tipula flavicans	x-w-f	.....	x-w-f	x-w-f	x-w-f	x-w-f	x-w-f	x-f-w	.....
Tipula abdominalis	.....	.....	.....	.....	.....	.....	x-w-f	x-w-f	.....
Pseudopyrellia cornicina	x-w-f	.....	x-w-f	x-w-f	.....	.....	.....	x-w-f	x-w-f
Musca domestica	.....	.....	x-w-f	x-w-f	x-w-f	x-w-f	x-w-f	x-w-f	.....
Syritta pipiens	x-w-f	.....	.....	.....	.....	x-w-f	.....	.....	.....
Mesograpta marginata	x-w-f	.....	x-w-f	.....	x-w-f	x-w-f	.....	.....	.....
Eristalis transversus	.....	.....	x-w-f	.....	.....	.....	x-w-f	x-w-f	x-w-f
Helophilus latifrons	.....	.....	x-w-f	.....	.....	.....	x-w-f	.....	x-w-f
Holomyza plumata	.....	x-w	.....	.....	.....	.....	.....	.....	x-w-f
Melanostoma mellinum	.....	.....	x-w-f	.....	.....	x-w-f	x-w-f	x-w-f	.....
Psilopodinus sipho	.....	.....	x-w-f	x-w-f	.....	x-w-f	x-w-f	.....	.....
Dolichopodidæ, sp. undetermined	.....	.....	.....	.....	.....	.....	.....	.....	x-w-f
Haematobia serrata	.....	.....	.....	x-w-f	.....	.....	.....	.....	.....
Promachus vertebratus	.....	.....	.....	x-w-f	.....	.....	x-w-f	.....	x-w-f
Promachus bastardii	.....	.....	.....	.....	.....	x-w-f	.....	.....	.....
Mesograpta polita	.....	.....	.....	x-w-f	.....	.....	.....	.....	.....
Eristalis dimidiatus	.....	.....	.....	.....	.....	.....	x-w-f	.....	.....
Helophilus similis	.....	.....	.....	x-w-f	.....	x-w-f	x-w-f	.....	.....
Tabanus sulcifrons	.....	.....	.....	.....	x-w-f	x-w-f	.....	.....	x-w-f
Tabanus costalis	.....	.....	.....	.....	x-w-f	.....	.....	.....	.....
Gastrophilis nasalis	.....	.....	.....	.....	x-w-f	.....	.....	.....	.....
Anthrax lateralis	.....	.....	.....	.....	.....	x-w-f	x-w-f	.....	x-w-f
Sparnopolius fulvus	.....	.....	.....	.....	.....	.....	.....	.....	x-w-f
Sarcophaga carnaria	.....	.....	.....	.....	.....	x-w-f	.....	.....	x-w-f
Tachinidæ, sp. undetermined	.....	.....	.....	.....	.....	x-w-f	.....	.....	.....
Peleteria robusta	.....	.....	.....	.....	.....	.....	.....	x-w-f	.....
Spallanzaria hesperidium	.....	.....	.....	.....	.....	.....	.....	.....	x-w-f
Lucilia caesar	.....	.....	.....	.....	.....	x-w-f	x-w-f	x-w-f	.....
Leria helvola	.....	.....	.....	.....	.....	.....	x-w-f	.....	.....
Pachyrhina ferruginea	.....	.....	.....	.....	.....	.....	x-w-f	.....	.....
Eristalis tenax	.....	.....	.....	.....	.....	.....	.....	x-w-f	.....
Euaresta bella	.....	.....	.....	.....	.....	.....	.....	.....	x-w-f
Atomosia puella	.....	.....	.....	.....	.....	.....	.....	.....	x-w-f
Leptogaster murinus	.....	.....	.....	.....	.....	.....	.....	.....	x-w-f
Diogmites umbrinus	.....	.....	.....	.....	.....	.....	.....	.....	x-w-f
Coleoptera.									
Diabrotica 12-punctata	x-w-f	.....	.....	.....	.....	x-w-f	x-w-f	.....	.....
Ips fasciatus	.....	.....	x-w-f	.....	.....	.....	.....	.....	x-w-f
Onthophagus hecate	.....	.....	.....	x-w-f	.....	.....	.....	x-w-f	x-w-f
Onthophagus pennsylvanicus	.....	.....	.....	x-w-f	.....	.....	.....	x-w-f	x-w-f
Geotrupes splendidus	.....	.....	.....	.....	.....	.....	x-w-f	.....	.....
Euphoria inda	.....	.....	.....	.....	.....	.....	.....	.....	x-w-f
Aphodius fimetarius	.....	.....	.....	x-w-f	.....	.....	.....	.....	.....
Pelidnota punctata	.....	.....	.....	.....	.....	.....	.....	.....	x-w-f
Aphonus tridentatus	.....	.....	.....	x-w-f	.....	.....	.....	.....	.....
Calligrapha similis	.....	.....	.....	x-w-f	.....	.....	.....	.....	.....
Epicauta pennsylvanicus	.....	.....	.....	x-w-f	.....	x-w-f	x-w-f	x-w-f	x-w-f

TABLE SHOWING INSECTS FED UPON.
(Continued.)

Order	Epeiridæ								
	Metepeira labyrinthea	Lecauge venusta	Epeira trivittata	Epeira domiciliorum	Epeira foliata	Epeira trifolium	Epeira gigas	Argiope trifasciata	Argiope riparia
Coleoptera (Continued)									
Epicauta vittata	.....	.....	.....	.....	.....	x-w-f	x-w-f	x-w-f	x-w-f
Agonoderus pallipes	.....	.....	.....	.....	x-w-f	.....	.....	.....	.....
Megilla maculata	.....	.....	.....	.....	.....	x-w-f	.....	x-w-f	x-w-f
Coccinnella 9-notata	.....	.....	.....	.....	.....	.....	.....	x-w-f	x-w-f
Epicauta marginata	.....	.....	.....	.....	.....	.....	.....	x-w-f	x-w-f
Diabrotica longicornis	.....	.....	.....	.....	.....	.....	.....	x-w-f	.....
Diabrotica 12-punctata	.....	.....	.....	.....	.....	.....	.....	x-w-f	x-w-f
Lema trilineata	.....	.....	.....	.....	.....	.....	.....	x-w-f	.....
Chelymorpha argus	.....	.....	.....	.....	.....	.....	.....	.....	x-w-f
Acmaeodena pulchella	.....	.....	.....	.....	.....	.....	.....	.....	x-w-f
Chlaenius pennsylvanicus	.....	.....	.....	.....	.....	.....	.....	.....	x-w-f
Harpalus caliginosus	.....	.....	.....	.....	.....	.....	.....	.....	x-w-f
Pterostichus lucublandus	.....	.....	.....	.....	.....	.....	.....	.....	x-w-f
Melanotus communis	.....	.....	.....	.....	.....	.....	.....	.....	x-w-f
Tetraopes tetraopthalmus	.....	.....	.....	.....	.....	.....	.....	.....	x-w-f
Cyllene robinæ	.....	.....	.....	.....	.....	.....	.....	.....	x-w-f
Phytonomus punctatus	.....	.....	.....	.....	.....	.....	.....	.....	x-w-f
Hymenoptera.									
Megachile infragilis	.....	.....	.....	.....	.....	.....	.....	.....	x-w-f
Bombus virginica	.....	.....	.....	.....	.....	.....	.....	.....	x-w-f
Myrmicidæ, sp	.....	.....	x-w-f	x-w-f	.....	x-w-f	.....	.....	.....
Augochlora viridulus	.....	.....	x-w-f	.....	.....	.....	x-w-f	.....	x-w-f
Mellisodes, sp	.....	.....	.....	.....	.....	.....	.....	.....	x-w-f
Vespa diabolica	.....	.....	.....	x-w-f	.....	.....	.....	.....	.....
Vespa germanica	.....	.....	.....	.....	.....	x-w-f	x-w-f	x-w-f	.....
Ichneumon volens	.....	.....	.....	x-w-f	.....	.....	.....	.....	.....
Ichneumon laetus	.....	.....	.....	.....	.....	.....	x-w-f	.....	x-w-f
Bombus vagans	.....	.....	.....	x-w-f	.....	.....	.....	.....	.....
Bombus americanorum	.....	.....	.....	.....	.....	x-w-f	x-w-f	x-w-f	x-w-f
Megachile latimanus	.....	.....	.....	x-w-f	.....	.....	.....	.....	x-w-f
Bombus separatus	.....	.....	.....	.....	.....	x-w-f	.....	x-w-f	x-w-f
Apis mellifica	.....	.....	x-w-f	.....	.....	x-w-f	x-w-f	x-w-f	x-w-f
Bombus fervidus	.....	.....	.....	.....	.....	.....	x-w-f	x-w-f	.....
Chrysis parvula	.....	.....	.....	.....	x-w-f	.....	.....	.....	.....
Agapostemon splendens	.....	.....	.....	.....	.....	x-w-f	.....	.....	.....
Halictus coriaceus	.....	.....	.....	.....	.....	.....	.....	.....	x-w-f
Colletes, sp	.....	.....	.....	.....	.....	x-w-f	.....	.....	x-w-f
Colletes speciosus	.....	.....	.....	.....	.....	.....	.....	.....	x-w-f
Tiphida inornata	.....	.....	.....	.....	.....	x-w-f	x-w-f	.....	x-w-f
Scolia bifasciatus	.....	.....	.....	.....	.....	.....	x-w-f	.....	x-w-f
Camponotus pennsylvanicus	.....	.....	.....	.....	.....	.....	x-w-f	.....	.....
Formicidæ, sp	.....	.....	.....	.....	.....	.....	.....	x-w-f	.....
Vespa maculata	.....	.....	.....	.....	.....	.....	x-w-f	x-w-f	x-w-f
Polistes bellicosus	.....	.....	.....	.....	.....	.....	.....	.....	x-w-f
Polistes pallipes	.....	.....	.....	.....	.....	.....	.....	x-w-f	x-w-f
Sphex ichneumon	.....	.....	.....	.....	.....	.....	.....	.....	x-w-f
Chlorion cyaneum	.....	.....	.....	.....	.....	.....	.....	.....	x-w-f
Ammophila extremitata	.....	.....	.....	.....	.....	.....	.....	.....	x-w-f
Ammophila nearctia	.....	.....	.....	.....	.....	.....	.....	.....	x-w-f
Pompilus americanus	.....	.....	.....	.....	.....	.....	.....	.....	x-w-f
Tremex columbia	.....	.....	.....	.....	.....	.....	.....	.....	x-w-f
Odynerus tigris	.....	.....	.....	.....	.....	.....	.....	.....	x-w-f
Odynerus forminatus	.....	.....	.....	.....	.....	.....	.....	.....	x-w-f
Ophion bilineatus	.....	.....	.....	.....	.....	.....	.....	.....	x-w-f
Hoplismenus morulus	.....	.....	.....	.....	.....	.....	.....	.....	x-w-f
Crabo 10-maculata	.....	.....	.....	.....	.....	.....	.....	.....	x-w-f
Other Spiders Eaten.									
Agelena naevia	.....	.....	.....	.....	.....	.....	.....	x-f-w	.....
Phidippus audax	.....	.....	.....	.....	.....	.....	.....	x-f-w	.....
Argiope trifasciata	.....	.....	.....	.....	.....	.....	.....	x-f-w	.....

THE SYRPHID FLY, MESOGRAMMA MARGINATA, AND THE FLOWERS OF APOCYNUM.*

RAYMOND C. OSBURN.

The flowers of the various species of the dogbane, *Apocynum* spp., have long been known to catch some of the weaker sorts of insects attracted by them, but as far as I am aware, no such wholesale slaughter of a particular species as that herein described has been noted. In fact, if I may judge by the conversations which I have held with both botanists and entomologists, the capacity of the dogbane for trapping insects has pretty generally escaped notice.

My own attention was drawn to the subject last summer when Miss Edith Weston, a young student of botany at the Ohio State University Lake Laboratory at Put-in-Bay, brought in some flowers of *Apocynum androsæmifolium* and called my attention to the fact that the flowers had "bugs" in them. A glance at the flowers showed that there were insects in nearly all of them and that these were all of one species, the common little Syrphid fly, *Mesogramma marginata* (Say). Many of these were still alive, though evidently held in such a manner that they could not escape. As the flowers are open bells, my curiosity was aroused and I began a careful examination.

Having in mind the related milkweed, *Asclepias*, whose flower clusters sometimes entangle the legs of insects by a sticky secretion, I was a little surprised to find that all of the flies in the *Apocynum* flowers were held by the proboscis. As many as four were present in some of the flowers, the little bell being as full as it would hold. Frequently the flies appeared to have made their escape by pulling off the terminal portion of the proboscis, and many of these parts were found in the flowers. Less frequently they had pulled off their heads in their struggles. In either case it would seem that the flies must "permanently vitiate their future careers" just as certainly as if they remained held.

In order to obtain some estimate of the number of flies caught, a hundred of the flowers were examined. These were taken just as they came on various flower clusters, and all were

*Contribution No. 61, Department of Zoology and Entomology, Ohio State University, Columbus.

taken that were sufficiently wide open to admit the flies. Of the 100 flowers, 81 contained flies or portions of them. Most of the 19 flowers that had not captured flies appeared very fresh, as though newly opened, and in some cases were, in fact, not yet fully open. Altogether 140 flies had been entrapped. Of this number, 32 were represented by the proboscis only and 21 by the heads, leaving 87 complete flies, alive or dead. The two sexes were represented in nearly equal numbers.

Knuth's Handbook of Flower Pollination, (translation by J. R. Ainsworth Davis, 1909, Vol. III, pp. 88–89), gives a very good account of the *Apocynum* flower and its method of pollination, quoted from Ludwig (Bot. Centralbl., Cassel, VIII, 1881, pp. 184–185). The anthers are stiff and are united to the bulbous style at about their middle. The lower half of the bulb bears the stigmatic surface, below the attachment of the anthers, while the pollen sacs open above the attachment. In pollination, the insect, in search of nectar, thrusts in its proboscis in such a manner that, to withdraw it, it must pull it upward between the edges of the anthers, and in so doing the proboscis comes into contact with the pollen. Then in visiting the next flower the pollen is brought into contact with the stigmatic surface. But for insects which are too weak to withdraw the proboscis properly, this arrangement forms what has been called a "pinch trap."

Ludwig discusses this pinch trap, as observed by him, and indicates the insects noted by Loew to have been caught by *Apocynum androsæmifolium* in the Berlin Botanical Garden. But one thing Ludwig failed to notice, or perhaps it was not shown in the flowers examined by him. Some of the flies are not held between the edges of the anthers at all, but are stuck fast on the outer surface of the anthers and, in one case observed, on the inner surface of the corolla.

There is therefore, another factor, not hitherto noted, in the process of entrapment, namely, the adhesive nectar. The presence of this factor is borne out by the behavior of the flies at work. *Mesogrammas* coming to a flower cluster were often seen to enter and emerge without difficulty for several times, but, as the same individual was watched, it would eventually be caught. Sometimes after a little difficulty, one would pull loose, but only to enter another flower, as though definitely bent on this particular form of suicide, when it would be per-

manently held. Prof. M. E. Stickney, of Denison University, confirmed this observation and we repeated it together a number of times.

The proper explanation appears to be that the flies are not held until the proboscis becomes sufficiently gummed-up with the sticky secretion. Larger insects appeared to have but little trouble, though in one case a drone fly (*Eristalis tenax*) was caught, by the proboscis, between the anthers. This is a robust, active fly a half inch or more in length.

The patch of *Apocynum* plants, on which these observations were made, was some sixty feet long by five or six feet in width. There were many thousands of the flowers and, if the 100 carefully examined form a sufficient basis for an estimate, there must have been at least as many of the flies caught as there were flowers. A careful survey of the flowers in the patch indicates that this estimate is not far from wrong.

Mesogramma marginata is a common little fly, 5 to 6 mm. long, but one seldom sees in it in such numbers. Its habits seem to indicate that in the larval stage it feeds on aphids, like many other Syrphid larvæ, and thus it is a beneficial insect. This being the case, the dogbane is a detrimental plant in regions where aphids do any damage.

INSECTS CAUGHT.—Aside from the *Mesogramma*, other insects appeared to visit the flowers without difficulty, though a few individuals of other species were caught. The list of those captured, as observed in several hours collecting at the patch on different occasions, is as follows: *Mesogramma marginata*, many thousands; *Eristalis tenax*, one; one small Tachinid; one small Muscid; and one small Tineid moth.

INSECTS NOT CAUGHT.—On each visit to the *Apocynum* patch, observations were made as to what were the regular visitors, and a collection was made of all the insects seen to enter the flowers. Insects were swarming about the flowers and most of the following list of 25 species were common: *Eristalis tenax, Syrphus americanus, Sphœrophoria cylindrica, Syritta pipiens, Limnophora narona, Peleteria robusta, Pseudopyrella cornicina, Anthrax alternata, Bombylius fulvibasis, Stomoxys calcitrans, Sarcophaga melampyga, Lygœus kalmii, Formica fusca subsericea, Apis mellifera, Megachile latimanus, M. brevis, Hylæus modestus, Heriades barbatus, Halictus sp., Basilarchia*

archippus, *Vanessa huntera*, *V. atalanta*, *Pholisora catullus*, *Thymelicus otho egeremet*.

Loew states that *Syritta pipiens* was caught at the Berlin Botanical Garden, but though this Syrphid was common at Put-in-Bay, none were held by the flowers.

Bembower (Ohio Naturalist, XI, No. 8, June, 1911, "Pollination Notes from the Cedar Point Region") gives a list of ten insects visiting the related species, *Apocynum hypericifolium*, but does not mention that any were captured by the flowers. Loew, however, noted that 56 flowers of this species in the Berlin Botanical Garden captured 88 small Muscids and Syrphids between early morning and 3 P. M.

Apocynum pubescens also grows at Put-in-Bay and some observations were made on the flowers for comparison. The blossoms are much smaller and do not open widely, so that it is more difficult for even so small a fly as *Mesogramma marginata* to enter them. However, a few of them had forced their way in and were held in the same manner.

In the Journal of Heredity for October, 1917, there is an unsigned article on "The Too-perfect Milkweed" which indicates that "specialization has over-reached the capacities of the organism specialized, and thus the specialization has defeated its own ends." It might appear at first glance that this is true of the flowers of *Apocynum*, for in some cases, at least, the flowers were so full of *Mesogrammas* that nothing else could enter, and if these were held on the first attempt to enter, such flowers would fail to be pollinated. However, it must be stated that in no case was a *Mesogramma* observed to be held on its first visit, but only after it had entered several flowers. It appears then, that a number of flowers might be pollinated even by this insect, before its proboscis accumulated enough of the sticky secretion or before this secretion evaporated sufficiently to become sticky enough to hold the fly.

Evidently the *Apocynum* flower is constructed in such a manner that insects, after reaching the nectaries, must ordinarily withdraw the proboscis through the slit between the anthers. At the same time the apparatus fails of perfect adaptation in that it does not exclude insects too weak to force the anthers apart. Moreover, to catch these insects defeats the purpose, so to speak, of the mechanism, by preventing, to some extent, the visits of other insects which might be more effective in producing pollination.

The old explanation was that such flowers penalize those visiting insects found guilty of being too weak to function satisfactorily as pollinators, by condemning them to death and carrying their execution into immediate effect. Even if such a teleological explanation appealed to one, he might with perfect propriety inquire what good it would do the flower to penalize itself with sterility at the same time, since the captured flies may block up the entrance to other insects. Moreover, if the insects learned anything by the death or capture of their fellows one could see the logic of such an explanation, but apparently they do not. Instead they keep on going to their death in spite of the "horrible examples" right under their noses, just as they have done, no doubt, for ages past, and the flowers, similarly, keep on interfering with their own pollination by holding the flies in captivity. Certainly, any flower that habitually clogs up its own system with insects, after devising special structures to prevent their being useful, is open to criticism by the etiologist.

Ohio State University, Columbus, Ohio.

EXPLANATION OF PLATE I.

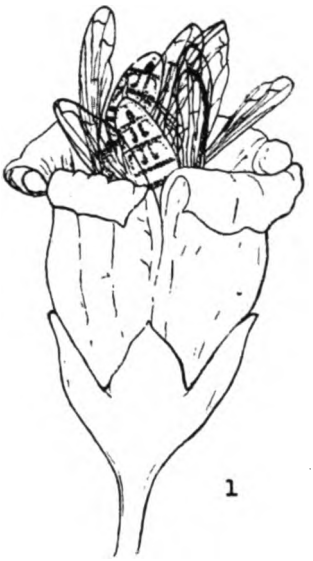
Fig. 1. Flower of *Apocynum androsaemifolium* with three *Mesogramma marginata* entrapped.

Fig. 2. Flower partly cut away, to show stigmatic surface of pistil (s), ring of attachment of anthers (r), nectaries (n), and opening of pollen sacs (p).

Fig. 3. Looking into a flower-cup, showing two heads of flies with proboscis caught between anthers, and part of a proboscis stuck on the outer side of an anther.

Fig. 4. Characteristic position of entrapped fly. The proboscis is held between the anthers close to their attachment to the stigma.

Drawings by Mrs. Walter V. Balduf.



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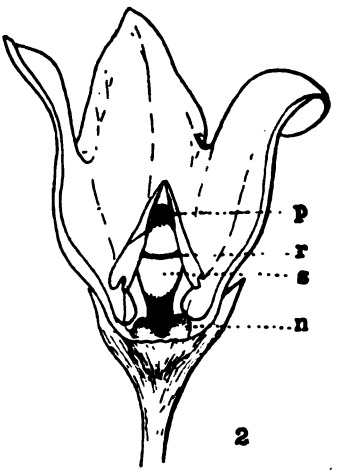

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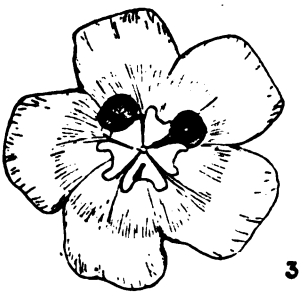

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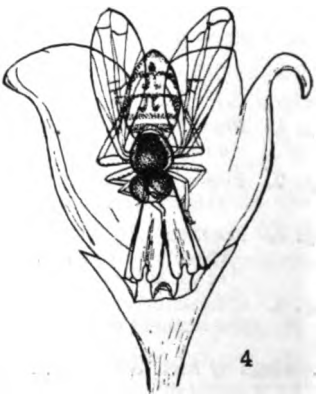

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R. C. Osburn

SCIENTIFIC RESULTS OF THE KATMAI EXPEDITIONS OF THE NATIONAL GEOGRAPHIC SOCIETY.

XII. DESCRIPTIONS OF DIPTERA OF THE FAMILIES ANTHOMYIDAE AND SCATOPHAGIDAE.

JOHN R. MALLOCH.
Illinois Natural History Survey

In presenting the descriptions of species of the genus Hylemyia I have added a key for their separation and include all of the species of the genus represented in the collections made by Professor Jas. S. Hine. Some of the species are recorded from this continent for the first time but there is no doubt as to their occurrence here as in most cases the specimens have been compared with European examples. Owing to the very great similarity of the species comprising the group I have figured the hypopygia of most of them in order that there may be no doubt as to the identity of the species in my hands and recorded here. It is not at all impossible that some of the species listed as new may be forms previously known from Europe though unrecognized by me.

SUBFAMILY PHAONIINÆ.

Phaonia albocalyptrata sp. n.

Male. Black, slightly shining, head, thorax, abdomen and legs with rather dense bluish gray pruinescence; orbits and cheeks with the pruinescence slightly silvery. Thorax with four black vittæ. Abdomen with a narrow black dorsocentral vitta. Legs entirely black. Wings clear, veins fuscous. Calyptræ and their fringes white. Knobs of halteres fuscous.

Eyes with moderately dense hairs; frons at narrowest part over three times as wide as distance across posterior ocelli; orbits with bristles on their entire length, each orbit one-fourth as wide as interfrontalia; arista almost bare; third antennal segment about 1.75 as long as second; parafacial as wide as third antennal segment, not narrowed below; cheek nearly twice as high as widest part of parafacial, with a series of setulæ above the marginal bristles. Two or three pairs of very weak acrostichals among the fine hairs proximad of the suture; prealar bristle a little over half as long as the bristle behind it; postsutural dorsocentrals 4; hypopleura bare; sternopleurals 1:2. Abdomen

narrowly ovate; basal sternite with some hairs; fifth sternite with a broad, shallow rounded posterior excision; hypopygium small. Fore tibia without long ventral hairs, median bristle, or apical posterior bristle; fore tarsus slender, longer than tibia; mid femur with rather long hairs on basal half of ventral and posteroventral surfaces, but without bristles; mid tibia with one posterior bristle; hind femur with fine bristles and long hairs on anteroventral surface, the posteroventral and ventral surfaces with long hairs on basal half; hind tibia with three or four anteroventral, and two anterodorsal bristles, the calcar short, about one-fifth of the tibial length from apex. Costal thorn short; outer cross-vein curved; last section of fourth vein about 1.75 as long as preceding section.

Length, 6 mm.

Type and two male paratypes, Savonoski, Naknek Lake, Alaska, July, 1919.

Phaonia citreibasis sp. n.

Male and Female. Glossy black; orbits and cheeks whitish pruinescent; thorax with gray pruinescence, distinctly but not conspicuously vittate; abdomen in male with a poorly defined dorsocentral vitta, in female entirely glossy black. Legs black. Wings clear, conspicuously orange colored at bases, the cross-veins narrowly infuscated. Calyptræ and halteres orange yellow.

Male. Eyes with very sparse short hairs; frons about as wide as distance across posterior ocelli; interfrontalia not obliterated; orbits setulose almost to anterior ocellus; parafacial as wide as third antennal segment, but little narrowed below; cheek nearly twice as high as widest part of parafacial, with a series of lower marginal bristles and some setulae above them; arista pubescent; third antennal segment over twice as long as second. Presutural acrostichals distinct, usually two weak pairs with many interspersed hairs; prealar bristle nearly as long as the bristle behind it; post-sutural dorsocentrals 4; hypopleura bare; sternopleurals 1:2 or 1:3. Abdomen elongate oval; basal sternite bare; dorsum with long bristles, especially apically; hypopygium small; fifth sternite with a broad basally truncate excision. Fore tibia without a median bristle, the ventral hairs distinct, but not long; fore tarsus slender, much longer than tibia; mid-femur with setulose hairs ventrally, those on basal half of posteroventral surface longer and stronger than the others; mid tibia without anterodorsal bristles, and with two to four posterior bristles; hind femur with a series of bristles on anteroventral surface and long hairs on posteroventral; hind tibia with two to four anteroventral, and two anterodorsal bristles, the calcar long, posterior surface with a few short hairs. Costal thorn short.

Female. Similar to male in thoracic chaetotaxy. The frons is one-third of the head width, the orbits narrow, each with 2+4 bristles and some weak setulæ. Legs without the long hairs present in male.

Length, 8 mm.

Type, allotype, and two paratypes, Savonoski, Naknek Lake, Alaska, July, 1919.

Mydaea hirtiventris sp. n.

Male. Black, shining, with bluish gray pruinescence on thorax and abdomen. Antennæ and palpi black. Thorax with four black vittæ. Abdomen unmarked. Legs black, hind tibiæ brownish. Wings clear, bases yellow. Calyptræ and halteres yellow.

Eyes separated by a little more than width across posterior ocelli; orbits setulose to anterior ocellus; interfrontalia distinct on its entire length; eyes nearly bare; parafacial as wide as third antennal segment, not narrowed below; cheek nearly twice as high as width of parafacial; arista with its longest hairs a little longer than its basal width; third antennal segment over twice as long as second. Prealar a little over one-third as long as the bristle behind it; sternopleurals 1 : 2. Basal sternite with numerous hairs. Fore tibia with the posteroventral hairs longer than usual; mid femur with strong bristles to beyond middle of posteroventral surface; mid tibia with two or three posterior bristles; hind femur with rather short, closely placed bristles on entire length of anteroventral surface, and some weaker bristles on basal half of posteroventral; hind tibia with two or three anteroventral and anterodorsal bristles, the setulæ on apical half of anterior surface stronger than usual.

Length, 7 mm.

Type, Katmai, Alaska, 1917. One male.

Hebecnema pallipes sp. n.

Male. Shining black, head with brownish pruinescence, thorax with faint grayish pruinescence, which is only visible when the surface is viewed from an angle of 45 degrees, abdomen densely brownish pruinescent, with a slight coppery tint, and without any markings. Legs yellowish testaceous, coxæ and tarsi fuscous. Wings slightly smoky. Calyptræ and halteres yellow.

Eyes bare, separated by not more than the width of anterior ocellus, the facets on upper surface much enlarged; parafacial linear; cheek a little higher than width of third antennal segment; longest hairs on arista about as long as width of third antennal segment. Chaetotaxy of thorax as in *umbratica* Fallen. Fifth sternite with a very deep, U-shaped posterior excision, the lateral extensions bare apically. Fore tibia without median or apical posterior bristles; mid femur with several bristles on basal half of posteroventral surface; mid tibia with two posterior bristles; hind femur with four or five bristles on apical half of anteroventral bristles. Outer cross-vein straight; inner cross-vein before apex of first vein; last section of fourth vein about 1.75 as long as preceding section.

Length, 5 mm.

Type, Katmai, Alaska, 1917. One male.

Limnophora tendipes sp. n.

Male. Black, opaque, densely gray pruinescent, with a bluish or greenish tinge on pleura and sides of abdomen. Back of head concolorous with thorax, the other parts densely silvery pruinescent. Thorax indistinctly vittate, two narrow submedian vittæ distinct anteriorly. Abdomen with most of first tergite, two large subtriangular spots on second and other two on third tergite, and a central one on fourth blackish. Legs colored as body. Wings clear, darker at bases. Calyptræ white. Halteres fuscous.

Width of narrowest part of frons over twice as great as distance across posterior ocelli; interfrontalia much wider than orbits, the latter with long setulose hairs on entire length; parafacial twice as wide as third antennal segment, and equal to height of cheek, the vibrissal angle produced much beyond base of antenna, in line with outer side of apex of third antennal segment, lower half of cheek hairy except anteriorly; arista swollen on basal fourth, almost bare; vibrissal angle with numerous setulose hairs, the vibrissæ not differentiated, situated much above lower margin of cheek; eyes with sparse fine hairs. Thorax with 4 series of fine presutural acrostichal hairs; postsutural dorsocentrals 4; sternopleurals 2; prosternum bare. Legs long and slender; fore tibia with one or two posterior median bristles, and a long apical posterior bristle; mid femur with a series of posteroventral bristles which become much shorter apically; mid tibia with one or two anterodorsal, two posterodorsal, two posterior and one or two posteroventral bristles; hind femur with long setulose hairs on basal half of posterior surface, and four or five bristles on apical third of anteroventral; hind tibia with three or four fine bristles on each of the following surfaces; anteroventral, anterodorsal, and posterodorsal; hind tarsus with a bristle near the base on ventral surface; apical tarsal segment on all legs broad. First posterior cell much widened at apex.

Length, 9 mm.

Type, Cordova, Alaska. One male.

SUBFAMILY ANTHOMYIINÆ.

Hydrophoria galeata sp. n.

Male. Black, slightly shining, thorax and abdomen with dense lead gray pruinescence. Head with dense pale gray shining tomentum on orbits, parafacials and cheeks; antennæ and palpi black. Thorax when viewed from behind indistinctly vittate. Abdomen when viewed from behind with an almost linear black dorsocentral vitta; hypopygium gray pruinescent, forceps glossy black. Legs black. Wings clear. Calyptræ white. Halteres yellow.

Narrowest part of frons not wider than distance between posterior ocelli; orbital hairs extending a little more than midway to anterior ocellus; interfrontalia obliterated at middle; parafacial at base of antenna wider than third antennal segment, but little narrowed below;

longest hairs on arista about equal in length to width of third antennal segment; cheek about equal in height to widest part of parafacial. Two or three pairs of strong acrostichals and many interspersed hairs in front of suture; prealar very short; hypopleura bare. Abdomen narrow, subcylindrical, tapered apically; no ventral tufts present; hypopygium small, the inferior forceps very long, slightly sinuous, thickened on apical half; fifth sternite with processes elongate, subcylindrical, their inner margins with a few fine hairs, their outer margins with a number of long bristles. Fore tibia with a median posterior bristle, the apical posterior bristle long; mid femur with some long bristles on basal half of posteroventral surface; mid tibia with an anterodorsal, and two posterodorsal and posterior bristles; hind femur with a series of anteroventral bristles and three or four bristles on middle of posteroventral surface; hind tibia with three or four posterodorsal, about eight anterodorsal and two or three anteroventral bristles, and two or three posterior setulæ. Costal thorn very short; outer cross-vein curved, very oblique.

Length, 7.5 mm.

Type, Katmai, Alaska, July, 1917. One male.

Hydrophoria congrua sp. n.

Male. Black, shining, with bluish gray pruinescence, most distinct on abdomen. Orbits and cheeks silvery when viewed from the side above. Thorax rather indistinctly quadrivittate. Abdomen with a black dorsocentral vitta, which tapers slightly posteriorly. Legs black. Wings slightly grayish. Calyptræ white. Halteres dull yellow.

Narrowest part of frons about as wide as distance across posterior ocelli; orbits haired to above middle; interfrontalia with a pair of fine bristly hairs above middle; parafacial a little wider than third antennal segment, hardly narrowed below; cheek as high as widest part of parafacial; arista with very short pubescence; third antennal segment not much longer than second. Thorax without distinct presutural acrostichals; prealar about half as long as the bristle behind it; hypopleura bare. Fifth tergite shining, pruinescent, with a few fine hairs; basal hypopygial segment with some long bristly hairs which are curved upward; fourth tergite not conspicuously bristly on sides; fourth sternite without conspicuous bristles; fifth sternite with rather short processes which are fringed with fine hairs on apical half of inner margins and have a dense fringe of longer setulose hairs at bases. Fore tibia with an anterodorsal and posterior bristle near middle; mid femur with long bristles on posteroventral surface; mid tibia with one anteroventral, one posterodorsal, three posterior and one posteroventral bristles; hind femur with long bristles on anteroventral and posteroventral surfaces, those on the last surface interrupted beyond middle; hind tibia with three anteroventral, seven or eight alternately long and short anterodorsal, and three long and one or two short posterodorsal bristles, posterior surface bare. Costal thorn short.

Length, 6.5 mm.

Type and paratype, Anchorage, Alaska, June 6, 1917.

Pegomyia lativittata sp. n.

Male. Black, slightly shining, densely gray pruinescent. Orbits and cheeks with silvery pruinescence; antennæ, arista, and palpi black. Thorax similar to that of *lysinoe* Walker, with a very broad black vitta behind suture on each side of dorsum and two linear submedian vittæ anteriorly. Abdomen with a uniform broad black dorsocentral vitta, and the posterior margin of each tergite black; hypopygium shining black, very slightly pruinescent. Legs reddish testaceous, coxæ, fore legs and all tarsi black, fore femora slightly paler than tibiæ, mid and hind tibiæ slightly darker than their femora. Wings slightly brownish, yellow at bases. Calyptræ and halteres yellow.

Narrowest part of frons barely wider than anterior ocellus; interfrontalia obliterated above middle; bristles confined to anterior half of orbits; antennæ elongate, third segment about twice as long as second; arista almost bare; parafacial at base of antenna as wide as third antennal segment; cheek a little higher than widest part of parafacial, with a series of bristles on lower margin. Three pairs of presutural acrostichals, between which there are four or more series of weak hairs; prealar nearly as long as the bristle behind it; sternopleurals 1 : 2. Abdomen slightly depressed, the bristles on apices of tergites long; hypopygium small; fifth sternite almost bare on inner margins of processes and without strong bristles. Fore tibia with one anterodorsal and two posteroventral bristles, the apical posterior bristle strong; fore tarsus much longer than tibia; mid femur with one bristle beyond middle and three on basal half of anterior surface, one beyond middle of anteroventral and a series of about eight on posteroventral surface; mid tibia with one anterodorsal, one posterodorsal, and two or three posterior bristles; hind femur with a series of bristles on anteroventral and four or five on middle half of posteroventral surface; hind tibia with one anteroventral, two anterodorsal, and two posterodorsal bristles. Lower calyptra not protruded.

Length, 8 mm.

Type, Savonoski, Naknek Lake, Alaska, July, 1919. One male.

Pegomyia jacobi sp. n.

Male. Black, slightly shining, densely gray pruinescent. Head black, the orbits and cheeks with silvery pruinescence. Thorax with the sides of dorsum more conspicuously pruinescent than disc; two linear vittæ apparent on anterior margin. Abdomen with a rather broad subinterrupted inconspicuous black dorsocentral vitta, the bases of the bristles set in black dots, fifth sternite with the processes glossy black. Legs reddish testaceous, coxæ, femora except their apices, and the tarsi black. Wings clear, yellow at bases. Calyptræ and halteres yellow.

Narrowest part of frons as wide as distance across posterior ocelli; interfrontalia not obliterated; orbits bristled on entire length; parafacial at base of antenna as wide as third antennal segment, narrowed below;

cheek as high as widest part of parafacial, with a series of bristles on lower margin; third antennal segment 1.5 as long as second; arista almost bare. Two or three pairs of closely placed acrostichals and some interspersed hairs in front of suture; prealar half as long as the bristle behind it; sternopleurals 2 : 2, the lower anterior one weak. Abdomen subcylindrical, the tergites with strong apical bristles; hypopygium of moderate size; fifth sternite with the processes chitinised, rounded at apices, bare on apical half internally and with some fine hairs basally on inner margins. Fore tibia with one anterodorsal and one posterior bristle, apical posterior bristle long; fore tarsus a little longer than tibia; mid femur without strong bristles on anteroventral surface, the posteroventral with a complete series; mid tibia with an anterodorsal bristle and adjacent to it on the anterior surface a weak setula, one posterodorsal and three posterior bristles; hind femur with a series of long, irregular anteroventral bristles and a similar posteroventral series which is interrupted before apex; hind tibia with two anteroventral, three anterodorsal, and two posterodorsal bristles. Costal thorn small; outer cross-vein slightly curved. Lower calyptra slightly protruded.

Length, 6 mm.

Type, Katmai, Alaska, July, 1917. One male.

Hylemyia Robineau Desvoidy.

I have not used the subgeneric names given to segregates of this genus by recent European authors. Included in the genus as recognized in this paper there are species which would fall into the restricted subgenera Hylemyia and Phorbia.

The following species are included in the key and recorded for the first time for this continent: *uniseriata* Stein, *fusciceps* Zetterstedt, and *sepia* Zetterstedt. Only in the case of the last named have I any doubt as to the identification. The species which has previously been identified by authors, including myself, as *fusciceps* Zetterstedt is *cilicrura* Zetterstedt according to Stein who has re-examined the types of the species.

The key here presented is not designed for the identification of all American species of the group as there are many more species which are not included and are closely related to those in the key.

Some of the hypopygial drawings are not mentioned in the text and reference must be made to the explanation of plates for names.

KEY TO MALES.

1. Third abdominal sternite of male deeply, roundly excavated in middle posteriorly, produced caudally on each side in the form of two long narrow processes which are armed with very long bristles that extend to or beyond apex of abdomen, the tips of the bristles forming fine hairs; legs of female entirely or almost entirely yellowish, the apical abdominal segment furnished with some stout curved spines. *setiventris* Stein

   Third abdominal tergite transverse at apex, not produced at each side caudally, in male; legs of female entirely or almost entirely black.....2

2. Fifth abdominal sternite with some very stout sharp spines on at least a part of the inner margin of each process.....3

   Fifth abdominal sternite with at most some setulæ on part of the inner margin of each process.....4

3. Spines on fifth sternite extending the entire length of the inner margins of the processes, longest at middle.....*spiniventris* Coquillett

   Spines on fifth sternite confined to basal half of each process, longest at base.....*marginata* Stein

4. Hind tibia with a close series of short, erect setulose hairs on one or other of the ventral surfaces; inferior forceps of hypopygium very long and slender.....5

   Hind tibia with at most a partial series of short setulæ on the posterior or posteroventral surface or on both (cf. *nidicola*).....8

5. Fore tibia with a very weak setula at apex on posterior surface; hind femur with long fine bristles on entire length of posteroventral surface; hind tibia with anteroventral and posteroventral setulæ.....6

   Fore tibia with a strong, slightly curved bristle at apex on posterior side, the apex of which is usually blunt; only the posteroventral surface of hind tibia with erect setulose hairs.....7

6. Parafacials much wider at base of antennæ than third antennal segment, and about one-third the width of eye; acrostichals very closely placed. *triseriata* sp. n.

   Parafacials about as wide as third antennal segment, and about one sixth the width of eye; acrostichals widely separated.....*fusciceps* Zetterstedt

7. Hind femur with a few bristles at extreme apex of posteroventral surface which are directed apicad; mid metatarsus without long setulose hairs on dorsal surface.....*cilicrura* Zetterstedt

   Hind femur with a series of closely placed fine bristles on more than apical half, which are directed basad; mid metatarsus with some long setulose hairs on dorsal surface.....*trichodactyla* Zetterstedt

8. Mid tibia with one or more anteroventral bristles on apical half.....9

   Mid tibia without any anteroventral bristles.....10

9. Fore tibia with a long blunt-tipped strong bristle at apex on posterior side; acrostichals in a single series, which is sometimes rather irregular. *uniseriata* Stein

   Fore tibia with a short weak sharp setula at apex on posterior side.....20

10. Fore tibia with a long strong, curved blunt-tipped bristle at apex on posterior side.....11

    Fore tibia with a short sharp pointed setula at apex on posterior side.....12

11. Mid metatarsus with very long bristles on dorsal surface; processes of fifth sternite each with two or three short blunt setulæ at apex on inner side (Fig. 3); arista pubescent.....*fabricii* Holmgren

    Mid metatarsus with normal hairing; processes of fifth sternite without short, blunt setulæ at apex on inner side.....*angustitarsis* sp. n.

12. Processes of fifth abdominal sternite very long, much curved, slightly widened at apices, their tips chitinised, glossy, almost bare outwardly, furnished with short pile-like hairs inwardly; eyes separated by about twice the width across posterior ocelli; hind tibia with two antero-dorsal bristles.....*constrictor* sp. n.

    Processes of fifth abdominal sternite not as above, much shorter, and usually straight, their tips not glossy.....12a

12a. Fifth abdominal sternite with a pair of contiguous downwardly projecting processes in center of the excavation, the apical lateral extensions of the sternite dilated apically (Fig. 5); pale gray species, the thorax with three pale brown vittæ; anterodorsal surface of hind tibia with ten to twelve setulæ from base to apex; halteres yellow... ***hinei*** sp. n.
Fifth abdominal sternite not as above; the species much darker than above and otherwise not as stated....13

13. Halteres brown or fuscous; very small species, not over three millimeters in length; fifth sternite somewhat similar to that of ***hinei*** (Fig. 6); hind tibia with very slender bristles; abdomen with very broad uniform black dorsocentral vitta which covers about one-fourth of the dorsum; acrostichals sparse, in two series....***fuscohalterata*** sp. n.
Halteres yellowish or whitish....14

14. Arista with the longest hairs at least as long as width of third antennal segment; hypopygium as in Figure 21....***variata*** Fallen
Arista with very short hairs or almost bare....15

15. Abdomen short and broad, rather thick, glossy and without distinct markings; hypopygium very large....***sepia*** Zetterstedt
Abdomen not as above, always distinctly pruinescent and more or less distinctly marked....16

16. Fifth abdominal sternite with dense short bristly hairs, one group which is downwardly directed at base of inner margin of each process, and another on apical half of each (Fig. 7); thorax very distinctly vittate; parafacials at least as broad at base of antennæ as third antennal segment; hind tibia with three or four anterodorsal bristles; acrostichals in two series....***atrovittata*** sp. n.
Fifth abdominal sternite not bristled as above; species differing in other respects....17

17. Hind tibia with two series of short setulæ on basal two-thirds, one on the posterior and the other on the posteroventral surface; small species, three or four millimeters in length; thorax distinctly vittate. ***nidicola*** Aldrich
Hind tibia with at most a few setulæ on posterior surface on basal half....18

18. Third and fourth abdominal sternites, each with some very long bristles along lateral margins; dorsal abdominal vitta broad....***planipalpis*** Stein
Third and fourth abdominal sternites not as above....19

19. Mid tibia with one or more anteroventral bristles on apical half....20
Mid tibia without anteroventral bristles....21

20. Prealar bristle not over one-third as long as the bristle behind it; acrostichals in four series, two of the hairs usually much longer than the others; hypopygium with a short process on disc, near base, on each side (Fig. 23)....***sericea*** sp. n.
Prealar over half as long as the bristle behind it; acrostichals in two rather irregular series, setulose, two of them very much longer and stronger than the others; hypopygium without processes on disc (Fig. 17)....***appendiculata*** sp. n.

21. Eyes separated by distinctly more than width across posterior ocelli; orbits very narrow above; interfrontalia with two pairs of fine setulæ above middle; prealar half as long as the bristle behind it; hind tibia slightly reddish; veins three and four divergent at apices....***aliena*** sp. n.
Eyes separated by less than width across posterior ocelli; hind tibia black....22

22. Thorax without any strong bristle-like presutural acrostichals, the hairs fine, in four series, one pair stronger than the others; hypopygium as in Figure 24....***incursa*** sp. n.
Thorax with at least one pair of bristle-like presutural acrostichals, the hairs all more or less setulose....23

23. Mid femur with some long anteroventral bristles....24
Mid femur without any long anteroventral bristles....25

24. Large species, 6 mm. in length; fifth abdominal sternite glossy along inner margins of the processes; inferior hypopygial forceps short and stout, curved, and with a tooth at middle on inner side....*denticauda* sp. n.
Smaller species, 4 mm. in length; fifth abdominal sternite and hypopygium not as above....24a

24a. Hind femur with a few long fine bristles on basal half of posteroventral surface; fifth abdominal sternite with very short fine hairs along inner margins of processes, but not fringed....*subnitida* sp. n.
Hind femur with short fine bristles on entire length of posteroventral surface; fifth abdominal sternite as in Figure 11, the inner margin of each process densely setulose at middle....*parvicornis* sp. n.

25. Prealar bristle over half as long as the bristle behind it; hypopygium as Figures 28 and 44....*tridens* sp. n.
Prealar bristle much less than half as long as the bristle behind it; hypopygium as in Figures 29 and 41....*substriata* Stein

Hylemyia triseriata sp. n.

Male. Black, faintly shining, densely pale gray pruinescent. Anterior margin of interfrontalia and lower part of parafacials slightly rufous brown. Thorax with three narrow dorsal brown vittæ. Abdomen with a black dorsocentral vitta which is slightly dilated at anterior margin of each tergite. Legs black. Wings slightly grayish, veins brown, paler basally. Calyptræ white. Halteres yellow.

Narrowest part of frons as wide as distance between posterior ocelli; interfrontalia distinct on its entire length, with a pair of fine bristles above middle; parafacial at base of antenna about 1.5 as wide as third antennal segment, very little narrowed below; cheek a little higher than widest part of parafacial, with numerous bristles along and slightly above lower margin, one strong one directed downward at middle and several weaker upwardly directed shorter bristles between it and anterior angle; arista pubescent, much swollen at base; third antennal segment about 1.5 as long as second. Presutural acrostichals very close together, two strong and two or three weak pairs; prealar about one-third as long as the bristle behind it. Abdomen moderately depressed, parallel-sided; fifth sternite with moderately stout processes, which are bare along their inner margins except at apex, where there are about four short, blunt setulæ, the outer half with numerous long bristles. Legs as in *fusciceps* Zetterstedt, the mid tibia with a strong anterodorsal median bristle, and the hind tibia with an anteroventral series of rather strong setulose hairs and the posterior and posteroventral surfaces each with a series of longer weaker setulose hairs. Costal thorn of moderate length.

Length, 6 mm.

Type, Katmai, Alaska, June, 1917. One male.

This species must be very closely related to *Hylemyia* (*Phorbia*) *biciliata* Coquillett, but the distinct markings on thorax and abdomen and different structure of the head appear to warrant its separation therefrom.

Hylemyia angustitarsis sp. n.

Male. Black, shining. Thorax indistinctly vittate. Abdomen with a black dorsocentral vitta which is broadened at anterior margin of each tergite, where it merges with the fuscous anterior marginal fascia; hypopygium glossy black, with slight grayish pruinescence. Legs black. Wings very slightly brownish. Calyptræ and halteres whitish yellow.

Head rather small; narrowest part of frons not much wider than anterior ocellus; parafacial at base of antenna not as wide as third antennal segment, much narrowed below; cheek as high as width of third antennal segment, with a series of long fine bristles on lower margin, some of which, anteriorly, are upwardly curved; proboscis normal; longest hairs on arista a little longer than its basal diameter; third antennal segment narrow, about 1.5 as long as second. Dorsum of thorax sparsely haired; presutural acrostichals of moderate, unequal lengths, irregularly 2-rowed; prealar less than half as long as the bristle behind it; sternopleurals 1 : 2; one or two bristly hairs adjacent to stigmatal bristle. Abdomen narrow, depressed; hypopygium of moderate size; fifth sternite with a few short, fine hairs along inner margins and on inner half of each process and some long bristles on outer half. Legs more slender than usual; fore tibia with a median posterior bristle, the apical posterior one long, curved, blunt at apex; mid femur with some long bristles on basal half of posteroventral surface; mid tibia with usually one posterodorsal and one posteroventral bristle basad of middle; hind femur with a series of rather widely spaced bristles on anteroventral surface and two bristles at apex on posteroventral; hind tibia with one or two weak bristles on both antero- and posteroventral surfaces, four or five short anterodorsal and three posterodorsal bristles. Costal thorn of moderate length; veins three and four very slightly convergent apically; outer cross-vein straight.

Length, 4.5–5 mm.

Type, Katmai, Alaska, July, 1917. Paratypes, Katmai, four specimens, August, 1917; Savonoski, Naknek Lake, Alaska, seven specimens, July, 1919, one specimen, August 1, 1919.

Hylemyia constrictor sp. n.

Male. Black, subopaque, densely pale gray pruinescent. Orbits, parafacials, face and cheeks with shining whitish pruinescence; antennæ and palpi black. Thorax indistinctly vittate. Abdomen with a poorly defined broad fuscous dorsocentral vitta which is laterally dilated at anterior and posterior margins of each tergite; apices of fifth sternite glossy black; hypopygium gray pruinescent. Legs black. Wings clear, veins black, whitish at bases. Calyptræ and halteres whitish.

Narrowest part of frons about twice as wide as width across posterior ocelli; interfrontalia distinct on its entire length, with a pair of bristles

in front of anterior ocellus; orbits with fine bristles to above middle; parafacial at base of antenna distinctly wider than third antennal segment and as wide as height of cheek, not narrowed below; cheek with a few long fine bristles along lower margin; arista nearly bare, much swollen at base; third antennal segment narrow, not much longer than second. Presutural acrostichals very fine and short, two-rowed; prealar about half as long as the bristle behind it; sternopleurals 1:2. Abdomen subcylindrical; hypopygium of moderate size; processes of fifth sternite very large, curved inward, their tips slightly broadened, glossy, and almost bare. Fore tibia with a bristle at middle on posterior side, apical posterior bristle weak; mid femur with sparse bristles to beyond middle on posteroventral surface; mid tibia with one anterodorsal and one posterodorsal bristle, and an anterior and two posterior setulæ; hind femur with a series of sparse anteroventral bristles; hind tibia with two anteroventral, two anterodorsal, and three posterodorsal bristles, and one or two posterior setulæ. Costal thorn very small; veins 3 and 4 slightly divergent at apices; outer cross-vein nearly straight.

Length, 5 mm.

Type, Valdez, Alaska, June 4, 1919. One male.

Hylemyia hinei sp. n.

Male. Black, subopaque, densely pale gray pruinescent. Thorax with a pale brown dorsocentral vitta which extends proximad of suture, and a broader, less distinct vitta on each side of it which does not extend proximad of suture. Abdomen with a moderately broad black dorsocentral vitta which is slightly interrupted at posterior margin of each tergite and connected with a narrow black fascia at anterior margin of each; hypopygium gray pruinescent. Legs black, gray pruinescent. Wings clear. Calyptræ white. Halteres yellow.

Head larger than usual, almost hemispherical; eyes separated by about width of anterior ocellus; orbits setulose to middle; parafacial narrower than third antennal segment, narrowed below; cheek nearly three times as high as widest part of parafacial, with long bristly hairs on lower margin anteriorly and above margin posteriorly; arista bare, swollen on basal fourth. Prealar not over half as long as the bristle behind it; presutural acrostichals rather widely separated, one or two pairs strong, a number of hairs between the strong pairs. Abdomen depressed, short and broad, slightly narrowed apically; fifth sternite with a pair of shining setulose processes at apex in center which project downward; hypopygium as in Fig. 26. Fore tarsus compressed, longer than tibia, the latter with one or two posterior bristles; mid tibia with two posterodorsal and two posterior bristles; hind femur with a series of anteroventral bristles, and a series of weaker posteroventral bristles which is more or less distinctly interrupted before apex; hind tibia with three posterodorsal, four to seven anterodorsal, and two or three anteroventral bristles, and some setulæ on middle of posterior surface. First posterior cell narrowed at apex.

Female. Similar in color to the male, the abdomen less distinctly marked. Interfrontalia velvety black. Wings yellowish at bases.

Interfrontal cruciate bristles present; each orbit about one-third as wide as interfrontalia, with three supraorbitals, the lower one directed outward, and three or four infraorbitals. Fore tibia with an additional anterodorsal bristle.

Length, 3.5–4.5 mm.

Type, allotype, and 15 paratypes, Savonoski, Naknek Lake, Alaska, July, 1919. Named for Jas. S. Hine.

Hylemyia fuscohalterata sp. n.

Male. Black, subopaque, densely gray pruinose. Orbits and and cheeks slightly silvery pruinescent. Thorax when seen from behind with five black vittæ. Abdomen with a broad black dorsocentral vitta which connects with a narrow black fascia on anterior margin of each tergite; hypopygium shining, gray pruinescent. Legs black. Wings slightly brownish, noticeably so basally. Calyptræ white. Halteres brownish, the knobs infuscated.

Narrowest part of frons about as wide as anterior ocellus; orbits haired to middle; parafacial nearly as wide at base of antenna as third antennal segment and as wide there as height of cheek, the latter with a series of fine bristles on lower margin; third antennal segment but little longer than second; arista nearly bare, swollen on basal third. Thorax with two or three pairs of fine presutural acrostichals and no interspersed hairs; prealar less than half as long as the bristle behind it; sternopleurals 1 : 2. Abdomen depressed at base, sides parallel; hypopygium of moderate size, Figure 22; fifth sternite somewhat similar to that of *hinei*. Fore tibia without bristles at middle and apex on posterior side; mid femur with long fine bristles on posteroventral surface; mid tibia with one or two small posterodorsal bristles; hind femur with long bristles on anteroventral and short setulose hairs on posteroventral surface; hind tibia with very fine bristles which are rather variable in number but average four on posterodorsal, two long and three short on anterodorsal, and two on anteroventral surface, the median part of posterior surface with some fine setulæ; tarsi subequal in length to tibiæ. Costal thorn minute; outer crossvein straight.

Female. Interfrontalia velvety black. Thorax not distinctly vittate. Knobs of halteres obscurely yellow.

Interfrontalia with a pair of cruciate bristles; lower supraorbital directed forward. Mid tibia with one anterodorsal, one posterior and two posterodorsal bristles. Tarsi shorter than tibiæ.

Length, 2.5 mm.

Type, allotype, and two paratypes, Katmai, Alaska, June, 1917.

Hylemyia atrovittata sp. n.

Male. Black, slightly shining, with grayish pruinescence. Head black, orbits, face, parafacials and cheeks with white pruinescence; interfrontalia anteriorly and upper anterior part of parafacials sometimes brownish red. Thoracic dorsum with five very conspicuous black vittæ, the interspaces drab gray pruinescent. Abdomen with a very broad black dorsocentral vitta which is slightly interrupted at posterior margin and connected with a narrow black fascia at anterior margin of each tergite; hypopygium glossy black, slightly gray pruinescent. Legs black. Wings slightly grayish. Calyptræ white. Halteres yellow.

Narrowest part of frons as wide as distance between posterior ocelli; interfrontalia not obliterated, with a pair of bristles above middle; orbits with long fine bristles to middle; parafacial at base of antenna a little wider than third antennal segment, not narrowed below; cheek higher than width of parafacial, with long fine bristles on lower margin, some of which, anteriorly, are upwardly curved; arista pubescent, much swollen on basal fifth; third antennal segment nearly twice as long as second. Presutural acrostichals long, two-rowed; many long hairs laterad of posthumerals; prealar not one-third as long as the bristle behind it; sternopleurals 1 : 2 or 1 : 3. Abdomen narrow, depressed; hypopygium of moderate size; fifth sternite with processes broad, furnished at base of each with a fringe of downwardly directed setulose hairs and on apical half with many similar hairs. Fore tibia with a median posterior bristle; mid femur with a series of bristles on posteroventral surface, their length decreasing to apex; mid tibia with two posterodorsal, and two or three posterior bristles; hind femur with a series of bristles on entire length of anteroventral surface and another on posteroventral, the latter almost ceasing before apex; hind tibia with two or three anteroventral, four or five anterodorsal and three or four posterodorsal bristles, and four or five posterior setulæ. Costal thorn very small.

Length, 4 mm.

Type, and 12 paratypes, Katmai, Alaska, June and July, 1917.

Hylemyia sericea sp. n.

Male. Black, slightly shining, densely brownish gray pruinescent. Head black, sometimes with the anterior part of interfrontalia and parafacials reddish; orbits, face and cheeks with yellowish pruinescence; antennæ and palpi black. Thorax indistinctly vittate. Abdomen with a slight silky luster, the black dorsocentral vitta linear. Legs black. Wings slightly brownish, veins dark brown, yellow at bases. Calyptræ and halteres yellow.

Narrowest part of frons as wide as anterior ocellus; orbits setulose to middle, and with a pair of very small hairs near anterior ocellus; interfrontalia almost obliterated above, with a pair of fine bristles at

middle; parafacial not as wide as third antennal segment, narrowed below; arista with microscopic pubescence; third antennal segment nearly twice as long as second. Presutural acrostichals very fine, in four series, usually one pair longer than the others; prealar about one-third as long as the bristle behind it. Abdomen depressed, sides subparallel; hypopygium normal in size, the superior forceps with a small process on each side of disc near base (Fig. 23); fifth sternite not abnormal (Fig. 12). Fore tibia usually with one anterodorsal and one posterior bristle; mid tibia with one or two anteroventral, one anterodorsal, two posterodorsal, and two posterior bristles; hind tibia with a series of long widely spaced anteroventral bristles which are at least as long at base as at apex; hind tibia with two to four anteroventral, about eight anterodorsal and four or five posterodorsal bristles, the bristles of the last two surfaces unequal in lengths, the posterior surface with a few setulæ near base. Costal thorn short and stout.

Length, 6 mm.

Type, Katmai, Alaska, July, 1917. Paratypes, one male, Katmai, June, 1917; Savonoski, Naknek Lake, five males, June, 1919, four males, July, 1919; one male, July 31, 1919.

Hylemyia appendiculata sp. n.

Male. Similar in color and markings to ***substriata*** Stein, and ***sericea***. Differs from ***substriata*** in having the prealar over half as long as the bristle behind it, the bristles on basal half of posteroventral surface of hind femur much longer and stronger, and the inferior forceps of the hypopygium much longer and with a small tooth or projection on inner side near apex, when seen from above (Figs. 17 and 34).

Length, 6 mm.

Type, Savonoski, Naknek Lake, Alaska, July, 1919. Paratype, Bozeman, Mont., June 23, 1916.

This species is very closely allied to ***anthracina*** Malloch, differing in having the presutural acrostichals more widely separated, the dorsocentral black abdominal vitta linear and not dilated on anterior and posterior margins of each tergite, the posteroventral bristles on hind femur much longer and sparser, and the mid tibia with an anteroventral bristle.

Hylemyia denticauda sp. n.

Male. Similar to ***substriata*** in color and habitus. Differs from that species in having two to three pairs of strong presutural acrostichals, the prealar nearly half as long as the bristle behind it, the fifth sternite glossy along inner margins of the processes and with fewer and shorter hairs, the mid femur with some strong bristles on basal half of anteroventral surface, and the hypopygium as in Figures 27 and 40.

Length, 6 mm.

Type and two paratypes, Seattle, Wash., May 25, 1919.

This species was taken by Professor Hine when on his way to Alaska and is appropriately included in this paper.

Hylemyia aliena sp. n.

Male. Black, slightly shining, densely gray pruinose. Head black, orbits, face and cheeks whitish pruinose; arista brown; palpi brownish yellow; proboscis glossy black. Thorax indistinctly vittate. Abdomen with a moderately broad dorsocentral black vitta which is slightly dilated at anterior margin of each tergite; hypopygium glossy black, with slight gray pruinescence. Legs black, hind tibiæ more or less noticeably reddish. Wings faintly brownish, veins dark brown and conspicuous. Calyptræ and halteres yellowish.

Narrowest part of frons distinctly wider than distance across posterior ocelli; orbits linear above, with bristly hairs to middle; interfrontalia with two pairs of fine bristles above middle, the upper pair small; parafacial at base of antenna as wide as third antennal segment and about three-fourths as wide as height of cheek, but little narrowed below; cheek with a series of setulose hairs on lower margin, vibrissal angle slightly produced; arista nearly bare, swollen on basal fourth, second segment as long as thick; proboscis rather slender. Presutural acrostichals short, two-rowed; prealar over half as long as the bristle behind it. Abdomen depressed, sides subparallel; hypopygium of moderate size (Fig. 25); fifth sternite without remarkable hairing (Fig. 8). Fore tibia usually with one anterodorsal and two posterior bristles; mid tibia with one anterodorsal, one posterodorsal and two posterior bristles; hind femur with a rather irregular series of bristles on anteroventral surface, and a posteroventral series of weaker bristles which does not extend to apex; hind tibia with two anteroventral, four or five anterodorsal, and three or four posterodorsal bristles, and two or three setulæ near middle of posterior surface. Costal thorn minute; penultimate section of fourth vein over two-thirds as long as ultimate; apical sections of third and fourth veins subparallel.

Length, 6 mm.

Type and one paratype, Savonoski, Naknek Lake, Alaska, June, 1919; two paratypes, same locality, July, 1919.

Hylemyia incursa sp. n.

Male. Similar to *sericea* in color, the interfrontalia and parafacial usually reddish anteriorly, and the abdomen with brownish pruinescence and a broad, poorly defined dorsocentral black vitta which is dilated at anterior margin of each tergite.

Arista distinctly pubescent. Presutural acrostichals fine and long, one pair longer than the others, but not bristle-like; prealar over half as long as the bristle behind it; posthumeral bristle not duplicated. Fifth sternite as in Figure 9; hypopygium as in Figures 24 and 43. Fore tibia with an anterodorsal and a posterior bristle; mid femur with

some long bristles on basal half of anteroventral surface; mid tibia with an anterodorsal, two posterodorsal, and two posterior bristles, and sometimes an anterior setula; hind femur with long bristles on anteroventral surface, and one or two on basal half of posteroventral; hind tibia with two or three anteroventral, five or six anterodorsal, and three or four posterodorsal bristles, and some setulæ on posterior surface near middle.

Length, 5.5 mm.

Type and three paratypes, Katmai, Alaska, June 10, 1919.

Hylemyia parvicornis sp. n.

Male. Similar in color to *substriata*. The anterior part of interfrontalia and part of parafacial reddish. Thorax rather indistinctly vittate. Abdominal dorsocentral vitta slightly dilated at anterior margin of each tergite.

Narrowest part of frons about as wide as anterior ocellus; interfrontalia distinct throughout, with a pair of long fine bristles above middle; orbits with setulose hairs to near middle; parafacial at base of antenna about as wide as third antennal segment, narrowed below; third antennal segment not twice as long as wide; arista pubescent, swollen at base. Three or four pairs of moderately strong presutural acrostichals present, one pair much longer than the others; prealar one-third as long as the bristle behind it. Fifth sternite as in Figure 11; hypopygium as in Figures 20 and 43. Fore tibia with a median posterior bristle; mid femur with some long bristle on basal half of anteroventral surface; mid tibia with one or two posterodorsal and posterior bristles; hind femur with the anteroventral bristles much longer on the apical than on the basal half, the posteroventral surface with short fine bristles on entire length; hind tibia with two or three anteroventral, four anterodorsal, and three posterodorsal bristles, the posterior surface with some setulæ at middle. Last section of fourth vein less than twice as long as preceding section.

Length, 4 mm.

Type, Kodiak, Alaska, June, 1917. Paratypes, four males, same locality, June, 1917.

Hylemyia subnitida sp. n.

Male. Differs from *parvicornis* in having the thorax less distinctly vittate, the abdomen with the dorsocentral vitta distinctly interrupted at apex of each tergite, and the parafacials black.

Parafacial narrower than in *parvicornis*, and the cheeks not so high, fifth sternite with very fine hairs along the inner margin of each process, though not fringed, mid tibia with a strong anterodorsal bristle, anteroventral bristles on hind femur longer and sparser, and those on posteroventral surface longer and not forming a complete series.

Length, 4 mm.

Type, Kodiak, Alaska, July, 1917. One male.

Hylemyia tridens sp. n.

Male. Similar in color and general habitus to *sericea.* Differs from *sericea* in structure of hypopygium (Figs. 44 and 28). The prealar is as in *appendiculata.*

Length, 6 mm.

Type and one paratype, Savonoski, Naknek Lake, July and August, 1919.

FAMILY SCATOPHAGIDÆ.

Amaurosoma Becker.

I included this genus in my key to the genera of Scatophagidæ in a paper on the Diptera collected by the Canadian Arctic Expedition, but up to the present no species of this genus has been recorded from America. In the present paper I describe three species as new.

The adults are predaceous, feeding on small Diptera and other small insects; the immature stages are unknown.

Amaurosoma katmaiensis sp. n.

Female. Black. Head with whitish pruinescence; thorax opaque, gray pruinose; abdomen shining, with very slight pruinescence. Head black; interfrontalia whitish yellow, face and cheeks concolorous; antennæ black, second joint inconspicuously yellow at apex; arista black; proboscis black; palpi yellow. Thorax not vittate. Legs black, tibiæ and tarsi flavous, the tarsi of mid and hind legs slightly darker. Wings clear, veins black. Calyptra white. Halteres yellow.

Frons fully half the width of head; orbits narrow anteriorly, becoming wider to anterior ocellus, the bristles rather weak; face slightly receding below; antennæ stout, nearly as long as face, third joint with sharp upper apical angle, rounded below; arista almost bare, much swollen on basal third; vibrissa strong, a strong bristle below it. Thorax with the presutural acrostichals weak, two-rowed. All abdominal segments with widely spaced bristles on posterior margins. Legs normal; fore femur with about nine long forwardly directed bristles in two to three irregular series on middle of antero-ventral surface; mid femur with six or more widely spaced bristles in similar situation; antero-ventral surface of hind femur with three or four widely spaced bristles; fore tibia with three bristles, one anterodorsal, one posterodorsal and one posterior; mid tibia with one bristle on each of the following surfaces—anteroventral, anterodorsal, posterodorsal and posterior; hind tibia with two or three anterodorsal and two or three posterodorsal bristles. Last section of fourth vein two or three times as long as preceding section; outer cross-vein at or more than its own length from apex to fifth vein.

Length, 4.5–6 mm.

Type locality, Katmai, Alaska, June, 1917 (J. S. Hine).

Type in collection of the Ohio State University; paratype in collection of the Illinois State Natural History Survey.

Amaurosoma unispinosa sp. n.

Female. Similar in color of head, thorax and abdomen to last species, except that the black on orbits does not extend so far forward. Legs and fore coxæ entirely flavous.

Cephalic characters, thoracic and abdominal chaetotaxy as in the preceding species. Legs stout, fore femora stouter than mid and hind pairs, armed with one bristle near base on anteroventral surface; mid femur with one or two anteroventral bristles at middle, and five or six along anterior surface; fore and mid tibiæ as in preceding species; hind tibia in type with two anterodorsal and two posterodorsal bristles.

Length, 4.5 mm.

Type locality, Katmai, Alaska, July, 1917 (J. S. Hine).

Type and paratype placed as in preceding species.

Amaurosoma bispinosa sp. n.

Female. Shining black, with distinct but not very dense gray pruinescence, which is very faint on abdomen. Antennæ black; frons on anterior half golden yellow; palpi pale yellowish testaceous; proboscis glossy black. Thorax glossy at bases of bristles. Legs yellowish testaceous, femora browned apically, tarsi infuscated. Calyptræ and halteres yellowish. Wings clear.

Third antennal segment about twice as long as second, not acute at apex above; arista tapered, microscopically pubescent. Presutural acrostichals sparse, two-rowed; intra-alars very weak; prealar moderately long; anterior sternopleural absent in type. Fore femur with two strong bristles at middle on anteroventral surface; mid femur with four or five bristles on anterior and anteroventral surfaces; hind femur with two weak anteroventral bristles at middle; hind tibia with two anterodorsal and two posterodorsal bristles. Last section of fourth vein about three times as long as preceding section.

Length, 5 mm.

Type, Saldovia, Alaska, June 5, 1919. One female.

Microprosopa Becker.

There are three species of this genus in the collection all of them apparently undescribed.

Microprosopa arctica sp. n.

Male and Female. Very closely resembling *dissimilis* in color, the female differing only in having the anterior half of frons whitish testaceous, the fore coxæ almost entirely yellow, and the fine hairs on thorax and abdomen pale. The male differs from that sex of several

other species in having the hypopygium dark, with paler color only on sides of venter.

Orbit with five bristles; third antennal joint rounded at apex above, cheek over one-fourth as high as eye, with one strong bristle and some weak marginal hairs in addition to the vibrissa, the bristles pale; palpi shorter and comparatively broader than in *dissimilis*. Presutural acrostichals two-rowed, but with some weak, pale hairs between the rows; disc of scutellum with very weak pale hairs. Fore femora swollen, with a few weak, black, bristly hairs on apical half of anterodorsal surface, and long soft hairs on posteroventral; fore tibia with one anterodorsal bristle; mid and hind femora without ventral bristles, the former with a few on apical half of anterodorsal surface, the hind pair with an almost complete series on same surface; mid tibia with one antero- and one posterodorsal bristle, the latter almost on the dorsal surface. Third and fourth veins subparallel or slightly convergent apically; sixth vein weak on apical half. Hypopygium of male very large; fifth sternite with the apices of the lateral processes glossy, rounded, their inner margins on basal half armed with very short, dense, erect hairs.

Length, 5–5.5 mm.

Type locality, Katmai, Alaska, July, 1917 (J. S. Hine). Six specimens.

Microprosopa triseta sp. n.

Female. Similar in color to *arctica*.

The head is slightly smaller than in *arctica*, the vibrissa and the bristle below it are black, the palpi are slightly more elongate, with the apices rather pointed. The presutural acrostichals are two-rowed, without any pale hairs between. The mid tibia in type has only one bristle on the anterodorsal surface, the hind tibia has in addition to the bristles present in *arctica* one on the anterodorsal surface near base. The venation is the same as in *arctica*, but the wing is more pointed, so that the apex of third vein is very decidedly beyond apex of fourth, while in *arctica* it is nearly in vertical line with it.

Length, 4.5 mm.

Type locality, Katmai, Alaska, July, 1917 (J. S. Hine).

Microprosopa dissimilis sp. n.

Female. Black; thorax densely yellowish gray pruinescent, almost opaque; abdomen slightly pruinescent, shining. Head black, anterior third of frons, the face and cheeks yellowish testaceous; antennæ and arista black, apex of second joint of former slightly pale; proboscis glossy black; palpi whitish testaceous, faintly infuscated at apices. Thoracic dorsum with two poorly defined narrow vittae anteriorly. Legs yellowish testaceous; all coxæ fuscous. Short hairs on thorax and abdomen black.

Each orbit with six bristles, the anterior three hair-like; arista bare, about one-third longer than antennæ, third joint of the latter slightly

angulate at apex on upper side; face slightly concave in profile; cheek about one-fifth as high as eye, with three strong and several weak bristles in addition to the vibrissa; palpi long, somewhat paddle-shaped. Presutural acrostichals two-rowed; disc of scutellum with setulose hairs. Fore femora stout, furnished with very short, dense, erect hairs on ventral surfaces, and on posteroventral surface with rather irregular long bristly hairs; fore tibia with three bristles, one anterodorsal, one posterodorsal and one posterior, the ventral setulæ dense and short; mid femora with numerous irregularly arranged weak black bristles on anterodorsal surface, and a few widely placed bristles on antero- and posteroventral surfaces; mid tibia with one antero- and one posterodorsal bristle, hind femur with armature similar to mid pair, except that the anteroventral bristles are stronger, more numerous and more closely placed; hind tibia with one anterodorsal and two posterodorsal bristles. Wing-veins thick; inner cross-vein just beyond apex of first vein and middle of discal cell; third and fourth veins very distinctly divergent at apices.

Length, 6 mm.

Type locality, Katmai, Alaska, July, 1917 (J. S. Hine).

EXPLANATION OF PLATES.

PLATE II.

Fifth abdominal sternites of males of Hylemyia.

Fig. 1, *fusciceps*, one side.
Fig. 2, *cilicrura*, one side.
Fig. 3, *fabricii*, one side.
Fig. 4, *angustitarsis*, one side.
Fig. 5, *hinei*.
Fig. 6, *fuscohalterata*.
Fig. 7, *atrovittata*, one side.
Fig. 8, *aliena*, one side.
Fig. 9, *incursa*, one side.
Fig. 10, *denticauda*, one side.
Fig. 11, *parvicornis*, one side.
Fig. 12, *sericea*, one side.
Fig. 13, *appendiculata*, one side.
Fig. 14, *tridens*, one side.
Fig. 15, *substriata*, one side.

PLATE III.

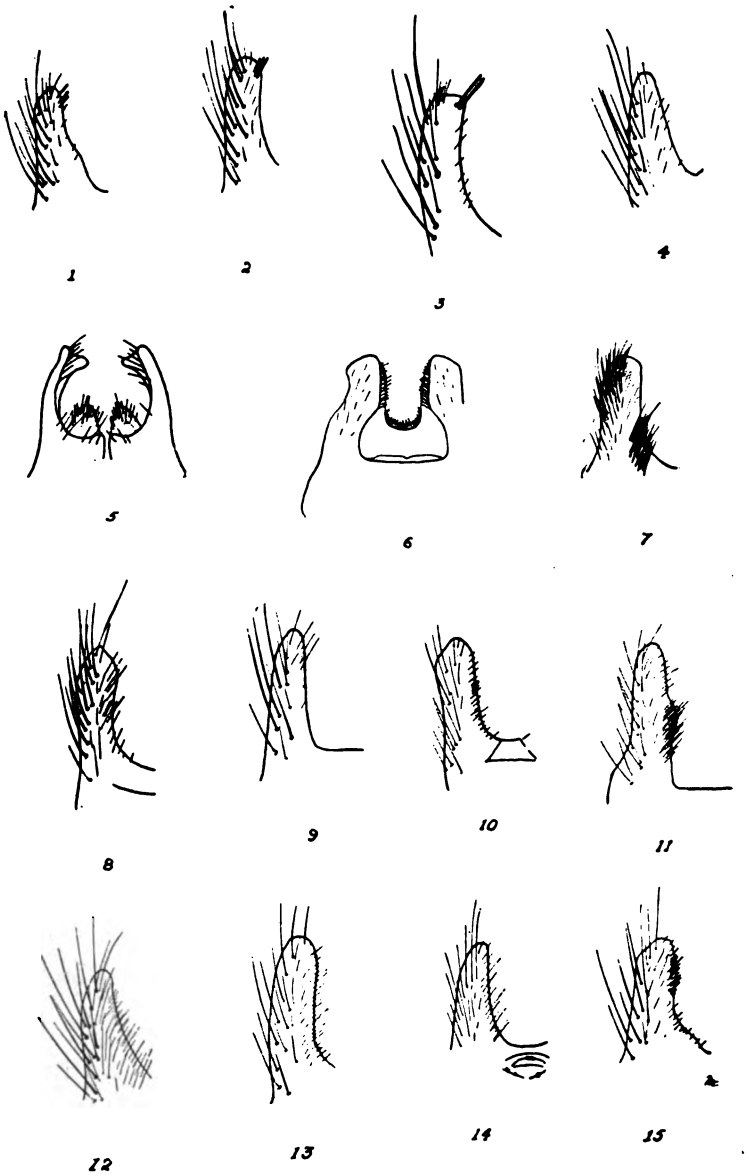
Hypopygia of males of Hylemyia, caudal view.

Fig. 16, *fabricii*.
Fig. 17, *appendiculata*.
Fig. 18, *angustitarsis*, one superior forceps removed.
Fig. 19, *atrovittata*, one side.
Fig. 20, *parvicornis*, one side.
Fig. 21, *variata*.
Fig. 22, *fuscohalterata*, one side.
Fig. 23, *sericea*, one side.
Fig. 24, *incursa*, one superior forceps removed.
Fig. 25, *aliena*.
Fig. 26, *hinei*, one superior forceps removed.
Fig. 27, *denticauda*.
Fig. 28, *tridens*, one superior forceps removed.
Fig. 29, *substriata*, one superior forceps removed.

PLATE IV.

Hypopygia of males of Hylemyia, lateral view.

Fig. 30, *fabricii*.
Fig. 31, *cilicrura*.
Fig. 32, *angustitarsis*.
Fig. 33, *hinei*.
Fig. 34, *appendiculata*.
Fig. 35, *fuscohalterata*.
Fig. 36, *variata*.
Fig. 37, *sericea*, forceps only.
Fig. 38, *sericea*, ventral processes.
Fig. 39, *atrovittata*.
Fig. 40, *denticauda*.
Fig. 41, *substriata*.
Fig. 42, *parvicornis*.
Fig. 43, *incursa*.
Fig. 44, *tridens*.



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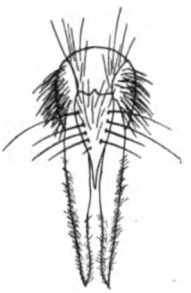

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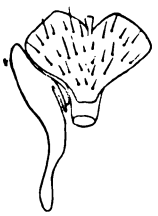

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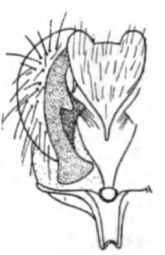

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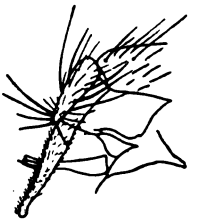

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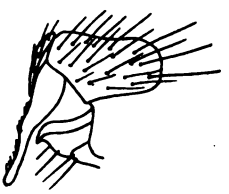

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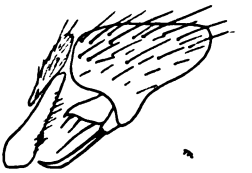

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XIII. BEES AND WASPS.

J. BEQUAERT.

Through the kindness of Prof. Jas. S. Hine, I have been given the opportunity to examine the Aculeate Hymenoptera obtained by him during his two trips to Alaska in the summers of 1917 and 1919. The following list of the species collected includes also a few specimens taken at Seattle, Wash. Mr. Viereck has kindly confirmed the identification of *Andrena frigida*.

A general account of the Hymenoptera of Alaska was given by Ashmead in 1902.* Some additional data has been published since, the most important contribution in this respect being F. W. L. Sladen's list of the wasps and bees obtained by the Canadian Arctic Expedition.†

APOIDEA.

The bee fauna of Alaska is exceptionally rich in bumble bees, comprising as many as 19 species of *Bombus* and 4 of *Psithyrus*. It seems rather strange that only one other bee, *Andrena frigida* Sm., is thus far known from that region.

BOMBIDÆ.

I have followed in the main Franklin's arrangement in his Monograph of this family (1913), but have added for convenience the synonyms used by Ashmead in 1902.

---

*W. A. Ashmead. Papers from the Harriman Alaska Expedition, XXVIII. Hymenoptera. Proc. Wash. Ac. Sci., IV, 1902, pp. 117-274, Pls. IX-XI.

†Report of the Canadian Arctic Expedition, 1913-18. III, Part G, 1919, pp. 26-35.

Bombus Latreille.

Terrestris group.

1. **Bombus lucorum** Linnæus var. **moderatus** Cresson.
   Kodiak, 2 ♀, 4 ☿, and 13 ♂, Sept., 1917. Katmai, 1 ♀, June 10, 1919. Savonoski, 1 ☿, July, 1919.

2. **Bombus occidentalis** Greene (*B. proximus* Ashmead; *B. mckayi* Ashmead).
   Seattle, Wash., 1 ♀ and 1 ☿ of the typical form, May 25, 1919.
   All the Alaskan specimens in the collection belong to the var. *proximus* Cresson: Katmai, 2 ♀, 25 ☿, and 1 ♂, Aug. 2, 1917; 1 ♀, June 10, 1919. Excursion Inlet, 1 ♀, May 31, 1919. Savonoski, 7 ☿, July, 1919.

Kirbyellus group.

3. **Bombus kirbyellus** Curtis.
   Katmai, 1 ☿, Aug., 1917.

Pratorum group.

4. **Bombus melanopygus** Nylander.
   Seattle, Wash., 1 ♂, May 25, 1919. Savonoski, 1 ♀ and 1 ☿, July, 1919.

5. **Bombus sylvicola** Kirby.
   Katmai, 8 ☿ and 1 ♂, July 28, 1917, and Aug., 1917. Savonoski, 1 ☿ and 2 ♂, July, 1919.

6. **Bombus gelidus** Cresson.
   Kodiak, 1 ♀, Sept., 1917. Katmai, 2 ☿ and 1 ♂, Aug., 1917. Valdez, 1 ☿, June 9, 1919.

7. **Bombus frigidus** F. Smith (*B. Couperi* Ashmead).
   Katmai, 1 ♀ and 4 ☿, Aug., 1917. Savonoski, 1 ☿, June 9, 1919.

8. **Bombus pleuralis** Nylander (*B. juxtus* Ashmead).
   Kodiak, 20 ☿ and 1 ♂, Aug., 1917. Kodiak, 2 ☿, Sept., 1917. Savonoski, 1 ♀, July, 1919.

9. **Bombus sitkensis** Nylander (*B. mixtuosus* Ashmead; not *B. sitkensis* Ashmead).
   Seattle, Wash., 1 ♀, 6 ☿, and 2 ♂, May 25, 1919. Katmai, 1 ♂, Aug., 1917.

10. **Bombus mixtus** Cresson (*B. oregonensis* Ashmead).

Seattle, Wash., 10 ☿ and 1 ♂, May 25, 1919. Kodiak, 9 ☿ and 3 ♂, Sept., 1917. Excursion Inlet, 1 ♀, May 31, 1919. Yakutat, 2 ♀, May 31, 1919.

Dumoucheli group.

11. **Bombus californicus** F. Smith (*B. neglectulus* Ashmead).

Seattle, Wash., 1 ♀, May 25, 1919. The species is also known from southern Alaska.

Psithyrus Lepeletier.

Laboriosus group.

1. **Psithyrus insularis** (F. Smith).

Seattle, Wash., 2 ♀, May 25, 1919. Katmai, 1 ♀, July 28, 1917.

2. **Psithyrus consultus** Franklin.

Savonoski, 1 ♂, July, 1919. As suggested by Franklin, this is most probably the male of *P. insularis*.

In addition to the foregoing, the following species of *Bombidæ* have been recorded from Alaska:

Bombus kincaidii Cockerell (*Psithyrus kodiakensis* Ashmead; *Bombus gelidus* Ashmead).

B. strenuus Cresson (?*B. frigidus* Ashmead).

B. *polaris* Curtis. Franklin regards Ashmead's Alaskan records of this species as questionable; it has, however, again been recorded from Alaska by F. A. Lutz (Bull. Amer. Mus. Nat. Hist., XXXV, 1916, p. 520) and Sladen (1919, p. 27).

B. arcticus Kirby. There are two queens of this from Point Barrow (Stefanson Coll.) in the American Museum of Natural History.

B. edwardsii Cresson (*B. nearticus* Ashmead).

B. flavifrons Cresson (*B. alaskensis* Ashmead; *B. dimidiatus* Ashmead).

B. alboanalis Franklin (*B. sitkensis* Ashmead).

B. (*Bombias*) *nevadensis* Cresson.

Psithyrus fernaldæ Franklin.

P. tricolor Franklin.

ANDRENIDÆ.

Andrena Latreille.

1. **Andrena frigida** F. Smith.

Valdez, 2 ♀, June 4, 1919.

Originally described on the female from Nova Scotia. Morice and Cockerell (Canad. Entom., XXXIII, 1901, p. 149) have published a few notes on the type specimen which is still preserved in the British Museum. Ashmead (1902, p. 131) records the male from Muir Inlet and Sitka.

VESPOIDEA.

In addition to the species mentioned below, *Ancistrocerus albophaleratus* (Saussure), one of the Eumenidæ, is known from Alaska (Ashmead, 1902).

VESPIDÆ.

Vespa Linnæus.

Only two members of this genus, *V. norwegica* and its var. *marginata*, have been heretofore recorded from Alaska; I have also seen from that region a female of *V. rufa* Linnæus var. *americana* R. du Buysson, a form not represented in the present collection.

1. **Vespa (Dolichovespula) diabolica** Saussure.

Katmai, 1 ♀, June 10, 1919. Savonoski, 5 ♀, 1 ♀, and 2 ♂, July and Aug., 1919. There is a male of this species from Skagway, Alaska, Aug. 42, 1918, (F. M. Jones Coll.), in the American Museum of Natural History.

2. **Vespa (Dolichovespula) norwegica** Fabricius (*V. borealis* Kirby, under which name the species is mentioned by Ashmead in 1902).

This is Sladen's *norvegicoides* (Ottawa Naturalist, XXXII, 1918, p. 71), which I am not prepared at present to separate from the European *norwegica*.

The collection contains only two specimens of the typical form, both from Savonoski; a ♂ taken Aug. 8, 1919, and a ♀, July, 1919.

This species has previously been recorded from Sitka and Virgin Bay by Ashmead (1902) and from Point Barrow (north of 70° N. lat.) by myself (Bull. Amer. Mus. Nat. Hist., XXXIX, 1918, p. 22).

var. **marginata** (Kirby) (*V. marginata* Kirby; *V. albida* Sladen).

Katmai, 4 ♀, June 10, 1919. Savonoski, 1 ♀, 5 ☿, and 3 ♂, Aug. 8, 1919.

In North America, this variety is known only from Alaska and the Yukon Territory, where it is apparently common. It has been recorded from Kukak Bay (Ashmead) and from Nome and Teller (Sladen). There are specimens from Alaska in the collection of the Brooklyn Museum and I have seen a ☿ taken at Kutlik (62° 30′ N., 63° W.).

Sladen (1919) has fully described this form, which he recognizes as a distinct species. I follow, however, R. du Buysson [Ann. Soc. Ent. France, LXXIII, (1904) 1905, p. 599] in regarding this as a mere variety of *V. norwegica*, from which it differs merely in the creamy white color of the body markings. Frequently, but not always, there are ferruginous red spots on the anterior edges of the second tergite in the male and worker. I find no trace of red on any of the five queens examined. The six workers seen all have the red spots, though in one example it is very small; of the three males, two have no red.

Two of the workers from Savonoski (with distinct creamy white fasciæ and lateral red spots on the second tergite) were taken from the same nest with a queen of typical *norwegica*.

3. **Vespa** (**Vespula**) **occidentalis** Cresson.
Seattle, Wash., 1 ♀, May 25, 1919.

4. **Vespa** (**Vespula**) **vulgaris** Linnæus.
Savonoski, 1 ☿, August 8, 1919.

This worker has the scape of the antennæ entirely black, a broad black longitudinal stripe on the clypeus, a median black spot on the yellow posterior orbits, and no yellow spots on the propodeum. I have seen several similarly colored workers from California and British Columbia. They agree well in coloration with European specimens of *Vespa vulgaris* and I have provisionally referred them to that species. They could, however, be aberrant specimens of *V. occidentalis*, though numerous workers of the latter species, which I have examined, all have the antennal scape yellow in front, the clypeus yellow with one or three black dots or small spots, the posterior orbits entirely yellow, and two yellow spots on the propodeum. The occurrence of true *V. vulgaris* on the northwestern coast of America would

be very interesting, but can only be definitely established through an examination of males from that region. In this connection it may be useful to add that all specimens from eastern North America which I have seen in collections identified either as *V. vulgaris* or as *V. germanica*, belong, in my opinion, to *Vespa communis* Saussure.

5. **Vespa** (**Vespula**) **acadica** Sladen, Ottawa Naturalist, XXXII, 1918, p. 72.

Savonoski, 1 ♀, July, 1919.

This interesting species is apparently the northern and boreal representative of *V. vidua* Saussure. In the American Museum of Natural History there are two workers from N. Ontario, Canada and Boisdale, Cape Breton, which also belong to *acadica;* but I have been unable to find a specimen of this species from the United States in any of the collections examined by me.

6. **Vespa** (**Pseudovespa**) **austriaca** Panzer.

Savonoski, 1 ♀, July, 1919.

This specimen agrees perfectly with the females found near New York in 1916 and which I have fully described in Bull. Brooklyn Ent. Soc., XI, 1916, pp. 102–103. Since, I have seen a female of this species from Mt. Hood, Oregon (G. P. Engelhardt Coll.) and a male from Beaver Mouth, Selkirk Mountains, British Columbia (J. C. Bradley Coll.). The genitalia of this male agree in every detail with those of a male from Thuringia, identified as *V. austriaca* by Schmiedeknecht.

American Museum of Natural History, New York City.

SURVEY OF THE FERNS AND FERN ALLIES OF OHIO.

Prof. L. S. Hopkins, of the Kent Normal School, Kent, Ohio, is organizing a survey of the entire state in order to obtain exact information about our Pteriodphytes and their geographical distribution. This work, if thoroughly done, will be of great interest and value, not only in giving us an exact list of the species, but adding information about the ecological and agricultural areas of the state. It is to be hoped that all botanists of Ohio and members of the Ohio Academy of Science will co-operate with Prof. Hopkins, either by making collections themselves or inducing some interested person to do so. In this way it should be possible to have one or more collectors in every county. The material should be sent directly to Prof. Hopkins, who will make determinations of the species.

JOHN H. SCHAFFNER.

Date of Publication, July 15, 1920.

The Ohio State University

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